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CHEMICAL AGE

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WASTE ACID RECOVERY

As a result of observations made on the reactions of coal gas or coke oven gas when in contact with sulphuric acid of various strengths W. C. Holmes and Co. Ltd. have developed a new process for the recovery of waste acid from benzole refining plant. A brief announcement about this process was reported in CHEMICAL AGE, 1 March, p. 403.

It was noted that if coal gas in the laboratory is passed through sulphuric acid of about 50 per cent concentration, cold, there is a slow growth of a brown solid deposit, although the character of the gas remains apparently unchanged. This is substantially the same reaction as occurs when crude benzole is agitated with sulphuric acid for the purpose of reducing its sulphur content and improving its purity and stability. In the gas experiments it was found that the gum or resin so produced was easily soluble in phenolic substances, and that the growth of the solid deposit was stopped when they were present. It thus appears, assuming a similar character for these resins to those which are produced by the refining of benzole, that phenols have a strong solvent property for the resins from crude benzole which are insoluble in sulphuric acid.

It is known that a number of benzole refiners have improved the separation of resins from the acid by agitating the mixture with coal tar creosotes, which normally contain 10 per cent to 30 per cent of phenolic substances. Success of this treatment is progressively enhanced by large proportions of phenol homologues. These treatments, however, while they may render the ultimate disposal of the acid rather more convenient, do not bring it into a state recognised as reasonably pure, even in a comparatively dilute condition as regards water content. It was therefore of importance to select a phenolic reagent that would intensify the treatment and give accurate and clean separation. After distillation, the normal mixture of three cresols was found to satisfy this requirement very well, resulting in sulphuric acid of a dark and turbid character being clarified to almost any desired extent by extraction with this reagent.

In most carbonising plants, manufacture of sulphate of ammonia is undertaken. The sulphuric acid can be used, at a stage in clarification which is easily identified, for the manufacture of sulphate of ammonia. Any difficulties of clogging of saturators by dirty acid are stated to be entirely eliminated and the ammonium sulphate product is of technical purity.

W. C. Holmes point out that the normal proportions of waste sulphuric acid from benzole refining, to the demands of the sulphate of ammonia plant, leave the recovered acid in a very small proportion. However, the sulphate of ammonia made by recovery acid alone fulfils technical requirements. The overall make of sulphate is therefore not contaminated by the recovered material, neither does the relatively low concentration of the latter upset the balance of the sulphate plant itself.

A number of benzole refineries cannot absorb the waste acid in other processes, such as the manufacture of sulphate of ammonia. Therefore it is attractive to bring back sulphuric acid into a reasonably clean and concentrated form, which would be marketable outside the works of its origin. Some have solved this problem by intensive extraction treatment,

plus reconcentration in a newly devised apparatus, employing temperatures within the range of boiler steam.

If it is desired to bring the sulphuric acid back to high concentrations (of the order of 75 per cent or upwards) careful handling of the reconcentration phase is required to avoid decomposition of any organic matter remaining in the acid. Oxidising agents proved beneficial in this instance.

Other refiners have preferred, however, to break down the mixture of crude acid and resin mixture by agitation with cold water, hot water, or steam. Weak acid derived by this treatment, it is understood, submits to the refining process described above.

As the mixture of the three cresols is a reagent of considerable cost, its immediate recovery is attractive. W. C. Holmes have, therefore, developed a scheme whereby the cresol plus resin mixture is to be redistilled in acid-proof apparatus, using inert gases as the vehicle for distillation, and again at temperatures available from ordinary boiler steam. This recovered cresol immediately goes back into the process, and allows the plant to be devised as a continuous cyclic treatment, without carrying large stocks of any reagents.

In benzole refining plants the crude acid may contain pyridine, due to mixing the preliminary acid wash with the true refining wash. The pyridine in the acid ultimately finds its way into the cresol mixture. It is preferable to avoid the presence of pyridine in the cresol mixture, but this can be dealt with should it be necessary to leave it in at the preliminary stages. It is also preferable to avoid admixture with neutralising liquids such as soda washes, as the sodium salts remain in the acid as impurity.

Provisional patent specifications taken out by W. C. Holmes (Nos. 34649/56 and 32269/57) give details of the plant. The plant is designed to take sulphuric acid at concentrations of about 30 to 60 per cent, delivered from steaming stills or oil agitation vessels as normally employed in the preliminary treatment. A continuous feed of the acid is thoroughly agitated possibly once or twice in succession with small proportions of the phenolic reagent. The acid at this stage is stated to be entirely suitable for sulphate of ammonia manufacture or for reconcentration, the degree of treatment being based on the requirements.

Cresol separated from any entrained sulphuric acid enters a distilling vessel in which the effective surfaces are of proprietary graphite construction and is subjected to heat and contact with inert gases, which pass out through a condenser and return the recovered cresols, etc., back to a feed tank. The gases are recycled through the gas pump back to the distilling vessel. A small proportion of resins accumulates in the latter and must be purged off from time to time. The used cresol could, of course be returned to crude tar, and recovered through ordinary processes of obtaining phenols from the tar distillates, but this is a roundabout treatment and is unlikely to be preferred.

The used cresols, however, could be mixed with coal tar creosote oil for the pretreatment of the acid and resin mixture. In fact, it has been shown that reinforcing of the phenol content of these coal tar creosotes, in such preliminary treatment is helpful. The crude mixture of resins, creosote oil and phenols can then be effectively heated as crude tar, and recycled with the latter through the tar distilling plant. Thus the bulk of the resins is disposed of into the coal tar pitch. Weight relationship between these resins and all the crude tar is so small that objection is extremely unlikely.

This new comprehensive treatment such as is described above is judged to be very welcome to those engaged in the operation of benzole refining on any scale, and to local authorities who have taken, with right, an unfavourable view of partial treatments hitherto practised. These local authorities have, however, withheld firm action as it could be stated that methods for satisfactory elimination of such a nuisance were not yet available.

RAPID VULCANISATION

DETAILS have just been released by Du Pont de Nemours Ltd., in the US of a new 'liquid curing medium' (LCM) process for rubber extrusions. The company claims rapid curing in 20 seconds, with a curing cost of 4 cents per 1,000 feet for neoprene tubing and an overall cost reduction of 25 per cent. Whereas extruded wire coatings now require continuous steam vulcanisers as long as 200 feet, the new process needs less floor space. Also reduced handling and labour result in considerable savings.

In the new LCM process, extruded, uncured compound is fed directly through a bath of molten metal or hot organic or silicone liquid. At 400° to 600°F rubber is cured within seconds. High temperatures characterise the new process.

Oil-resistant compounds such as neoprene can be cured with inexpensive high-flash mineral oils. Commercial heat-stable silicone oils are also said to be good but as they are relatively expensive, reclaiming may be necessary for economical operation. Liquid metals, state Du Pont, appear to be practical, all-round LCM heat transfer materials with a preference for a bismuth-tin eutectic (58 per cent bismuth and 42 per cent tin—Asarcoto 281 alloy.)

Extruded compound is run through a talc box and into the liquid metal bath. The cured material is stated to come out clean, ready for packing. If oils are used as heat transfer agents the passage through the talc is omitted, but a solvent bath or detergent wash is added after the LCM tank to remove the oily coating. The oils are stated to be preferable to the metal bath for soft, hollow, thin-walled tubing.

Compounds are cured at 15 to 20 feet per minute in a pilot plant but commercial plant operates at up to 60 feet per minute. Future speeds of up to 100 feet per minute are considered possible by Du Pont.

The most effective accelerators for neoprene using the new process are reported to be thioureas and aldehyde amines. Diethyl thiourea is understood to be very good as it melts at 170°F and can be easily dispersed by the extruder. At 425°F curing is effected in 20 seconds. Conventional accelerators cure neoprene at a similar rate but a temperature of about 100°F higher is necessary.

To reduce porosity, plasticisers or other additives should be avoided, as these volatilise at the higher temperatures used in the LCM process. Entrapped air and gases can be removed by using a vacuum-type extruder. With this type of extruder the LCM process can also be used for 10 durometer, non-black compounds and highly extended compounds. Surface finish is claimed to be excellent.

NEW STEROID ROUTE?

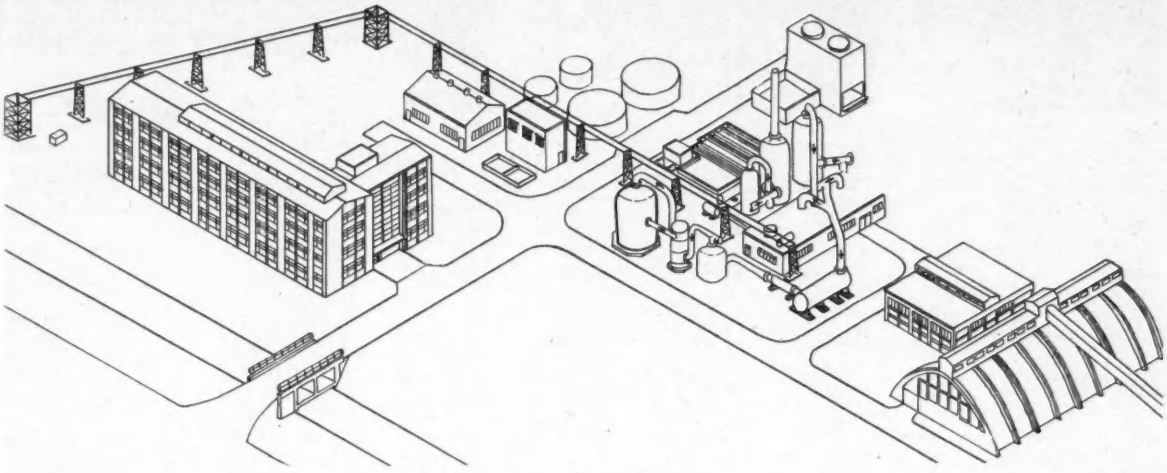
A PROCESS which it is believed will permit making 21-hydroxyl cortical compounds more rapidly and easily than methods employed at present is reported from research workers at Columbia University. In addition to simplicity the process is said to be applicable to almost any starting 20-ketosteroids.

Basically the new method treats 20-ketosteroids with iodine in the presence of calcium carbonate. A 21-iodo-20-ketosteroid intermediate is formed which then reacts with potassium acetate.

Techniques in use at present include base condensation of a 20-ketosteroid with ethyl oxalate, halogenation and removal of the oxalyl group. This method does not work with compounds such as the 17-hydroxyketones which can only be produced by direct halogenation when no interfering keto group is present.

The new technique devised by Gilbert Stork and Howard J. Ringold is claimed to overcome the disadvantages mentioned above. Also of interest is the fact that after the first iodine has attached itself, the reaction stops, unlike the usual haloform reaction.

BRITISH TITAN'S NEW SULPHURIC PLANT



REFERENCE has been made to British Titan Products Co. Ltd.'s plans to install a large sulphuric acid plant adjacent to its pigment works at Billingham. (see CHEMICAL AGE 1 March 1958, p 389.) In 1934 BTP started production of titanium oxide pigment using sulphuric acid supplied from the adjacent plant of Imperial Chemical Industries Ltd. Recently, however, the demand for sulphuric acid in the Tees-side area has increased considerably, and shows every sign of continuing to do so, so that new capacity to produce sulphuric acid is needed. BTP, by constructing its own acid plant to provide all its own requirements of this major raw material in the titanium oxide industry, will help in meeting this need.

A new site on the east side of Haverton Hill Road has been obtained and civil work has started. The land is close to the River Tees and has a poor bearing capacity, necessitating the plant being founded on piles of approximately 40 ft. length.

98 per cent efficiency

The plant will use the conventional sulphur burning process and is being supplied by Chemical Construction (Great Britain) Ltd., London. It will have a capacity of 250 tons a day of 100 per cent sulphuric acid at 93 per cent or 98 per cent or any intermediate concentration, and facilities will also be available for the production of oleum. The overall conversion and absorption efficiency will be not less than 98 per cent.

Sulphur will be received on site from adjacent wharves, and will be stored in a reinforced concrete silo capable of holding 5,000 tons.

Sulphur melter pits will be situated at one end of the silo and the sulphur conveyed from the stockpile to the melters by means of a mechanical shovel. From the melters, the molten sulphur will be pumped to sulphur guns and burnt with dried air in a horizontal furnace to sulphur dioxide. The gases will then pass through a water tube boiler with external steam drum operating at 350 p.s.i., and then through a gas filter to a multi-stage converter. The steam produced by the acid plant will be used in the titanium pigment plant accross the road.

The sulphur trioxide leaving the converter will pass via an economiser to the acid absorption towers, from which the acid will be discharged to storage tanks.

The water intake and effluent discharge will be very small as the cooling water will be circulated over a concrete forced draught cooling tower. The boiler feed water will be softened in base exchange softeners.

It is expected that the new plant will be completed in July, 1959.

In Parliament

Firm Warned About Nationalisation Was Foreign-Owned Ashburton Chemicals

QUESTIONED in the Commons about a recent speech in which he said that a foreign chemical firm had decided not to go to South Wales because he could not give it a guarantee that the chemical industry would not be nationalised, Sir David Eccles, President, Board of Trade, said that Ashburton Chemicals, a British subsidiary of a foreign chemical firm, had been considering for some time the possibility of setting up a factory in Caernarvonshire. The BoT would continue in close touch with the firm to do all it could to overcome the remaining difficulties in the way of completing the arrangements for the factory. One other chemical firm was known to the BoT to be at present actively considering sites in other parts of Wales.

Mr. A. Robens (Lab., Blyth) then asked (1) whether the foreign chemical firm, which recently felt unable to establish a factory in Wales, intended to base its chemical production on oil or coal; (2) whether the foreign chemical firm, which recently made inquiries with a view to setting up production in Wales, intended to supply chemicals to the British home market, the export market, or both.

Sir David replied that the firm's intentions had been discussed in confidence with the Board of Trade, and he would not regard it as desirable to reveal them at that stage, but he could say that the intention was to export as well as manufacture for the home market.

Later, Mr. Robens asked whether Sir David would urge the UK chemical industry to increase production so as to render unnecessary the establishment of foreign chemical firms in this country.

Replying in the negative, Sir David said that they welcomed, in general, foreign investment in industry. In the last 10 years the production of the chemical industry had almost doubled in volume. That record spoke for itself.

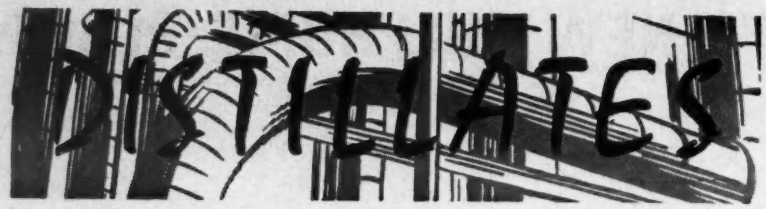
(Ashburton Chemicals is owned by the Swiss parent company of Geigy Co. Ltd., Geigy AG., Basle. Ed.)

US Investment in Refineries

The Parliamentary Secretary to the Ministry of Power, Sir Ian Horobin, stated in a written answer that gross capital expenditure on oil refineries erected in this country by subsidiaries of US companies since January 1946 amounted to about £95 million.

Methane Exempt Import Duty

The Treasury has made the Import Duties (Exemptions) (No. 4) Order, 1958, which exempts methane from duty under the Import Duties Act, 1932. The Order came into operation on 2 April.



★ QUICK recovery to full production is reported by Griffin and George (Laboratory Construction) of Alperton, Middx. after losing by fire their Birmingham joinery works on 25 February. After salvage operations, the company had the use of workshop facilities which allowed them to give effective employment to 50 of their skilled bench workers. By 'feeding' machined parts provided by friends in the industry, production was revived in one week.

I now learn that the unit has transferred complete to larger premises at Walsall Road, Perry Barr, Birmingham 22B and all the personnel have been working again under one roof from Thursday this week. So the company can not only maintain its service but will be able to expand production to meet the increasing call for quality laboratory furniture.

The group's output of scientific apparatus is not affected by the fire, for all instrument production is sited at other factories in Frederick Street, Birmingham, and at Mitcham, Surrey.

★ GOLDEN JUBILEE meeting of the American Institute of Chemical Engineers to be held in Philadelphia in June will feature a unique technical programme summarising 50 years of chemical engineering and taking a searching look at the future. The various symposia will range from salaries, through education to basic principles in chemical engineering, future trends in kinetics and reactions, process control, etc.

In addition there will be sessions on chemical engineering in the nuclear field and in missiles. To complete the modern look of this programme there will be a meeting on the use of motion pictures in chemical engineering technology.

The institute expects a record attendance, among whom will be three UK delegates. Dr. J. A. Oriel will represent the Institution of Chemical Engineers, Mr. A. J. Young of ICI's central instrument laboratory, Reading, will give a paper on 'Developments and trends in process control in Europe'; and Professor K. G. Denbigh of Edinburgh University will present a paper on 'Thermodynamics of irreversible processes'.

★ A NEW ROAD tanker, capable of carrying more than 300,000 cu. ft. of liquid oxygen, and with a bonnet about as big as a bubble car, has been introduced by British Oxygen Gases Ltd. It is believed to be the largest of its kind in the world and it will go into service in the company's Yorkshire district. It is planned to put five similar tankers into service by the end of the year.

The cylindrical oxygen tank is supported on an articulated Scammell chassis and the vehicle has an 11.1 litre 6-cylinder Leyland engine. The overall weight is 24 tons, of which approximately 13 tons is payload. It has a length of 32 ft. 6 in., is 11 ft. 7½ in. high and 7 ft. 10½ in. wide.

The new tankers, which will carry oxygen in liquid form at −186°C, are being built at the Watford works of Scammell Lorries with the co-operation of British Oxygen Engineering and the tank was executed by the APV Company. It has a maximum speed of 30 miles per hour. A special pressure-raising coil enables the oxygen to be discharged from the tank in approximately one hour.

★ DOW CHEMICAL of Midland, Michigan, US, are already planning to take advantage of the new St. Lawrence seaway development. They are now building a new marine terminal at Bay City on Lake Huron. The aim is to place Dow's production facilities in the American midwest on a better competitive basis by bringing them the advantage of being on water navigable for seagoing vessels.

Vessels will load chemicals at Bay City and at the Sarnia, Ont., docks of Dow Chemical of Canada and then sail for Rotterdam up the St. Lawrence. Rotterdam is the base of the company's Dutch subsidiary.

While this great new seaway will help North American exporters of chemicals it will give UK producers a direct access by sea to important industrial areas of both the US and Canada. If passage tolls are not too high it should give an economic advantage over shipment to east coast ports.

★ WILL textile colouration eventually be reduced to a mere painting of fibres with ready mixed paints and will all the research work on the physical chemistry of dyeing processes be wasted? Answering this in a recent paper Dr. T. Vickerstaff, chief colourist of ICI's dyestuff division, felt it would be difficult to bring a very strong argument against the thesis.

Two defects of a pigment resin system, however, seem to be unavoidable, namely, that severe wear must remove any surface coating in time, and so lead to whiteness, and secondly, that the use of resins in quantities sufficient to fix heavy shades must inevitably cause fibre to fibre adhesion. Will these difficulties be accepted as unimportant in the future? Dr. Vickerstaff could not see the ultimate outcome of this development but felt that an increasing use of pigments on textiles was inevitable in view of the increasing difficulties of colouring fibre unions.

Another use of pigments is in the mass colouration of viscose rayon fibres, where no difficulty arises from handle. Again results of high fastness are obtainable and the only limitation of advance in this field is the restricted range of shades which is imposed by economic considerations.

Dr. Vickerstaff's paper was 'Progress in textiles; a review of developments and their effects on industry and user-dyeing and finishing'.

★ EXTENDED experiments are being carried out by London Transport in the use of silicone materials in place of mica-based materials for the insulation of armature windings of traction motors and other equipment on the London Underground rolling stock. It is hoped that these will yield important results in prolonging the life of armatures, giving the motors improved performance and reliability and economy of maintenance, and eventually in permitting reductions in the weight and the cost of traction motors.

Most failures in traction motors arise from the thermal ageing of the insulation which leads to carbonisation and tracking. Silicone materials have been found to possess a more stable chemical structure than mica and most organic insulating materials, and their decomposition, when it takes place, leaves no electrically conducting products. They are better able to withstand elevated temperatures and are less liable to thermal ageing.

Their use appears, subject to large-scale experience under actual running conditions, to offer substantial advantages in the general efficiency of traction motors. The ability of silicone insulation to withstand high temperatures may also permit a reduction in the size of a machine for a given output by enabling it to be run closer to the limit of its rating.

★ I SEE that the DM.30 million compensation agreement concluded between the IG Farben liquidation office and former concentration camp inmates became final on 1 April, after the expiry on 31 March of the time limit set for objections from either side. As a result the blocked 50 per cent of the share capital of the Hüls holding company becomes releasable.

This explains the advance of IG Farben liquidation vouchers from 33 to 41 points within the last few weeks. For each Reichmarks 1,000 of old IG Farben shares, DM.60 shares of the Chemische Verwaltung AG, a holding company of Hüls, will be distributed. This company, I learn, owns half of the DM.120 million share capital of the Hüls Chemical Works, in addition to DM.35.5 million of 7½ per cent Hüls bonds, accumulated interest and dividends of IG Farben assets abroad (seized during the war) and 'shadow' assets in the Soviet zone.

Of particular interest is the belief that the 'big three' successor companies of IG Farben, namely Bayer, Badische and Hoechst, have bought a considerable number of IG Farben liquidation vouchers in order to acquire an interest in the Hüls Chemical Works, considered one of Germany's most modern chemical plants.

Alembic

LARGEST UK CARBONISATION PLANT

NCB's £9 Million Project at Manvers Main

TODAY the Manvers Main coking and by-products plant at Wath-on-Dearne, near Doncaster, is the largest in the country. In 1949 the National Coal Board (NCB) began a minor scheme for the erection of some new ovens and the rebuilding of old ovens. This was followed by a £9 million major reconstruction and development scheme which is now virtually completed.

Designed to carbonise one million tons of coal a year, the plant has a carbonising section comprising 137 coke ovens with conventional equipment for the recovery of by-products.

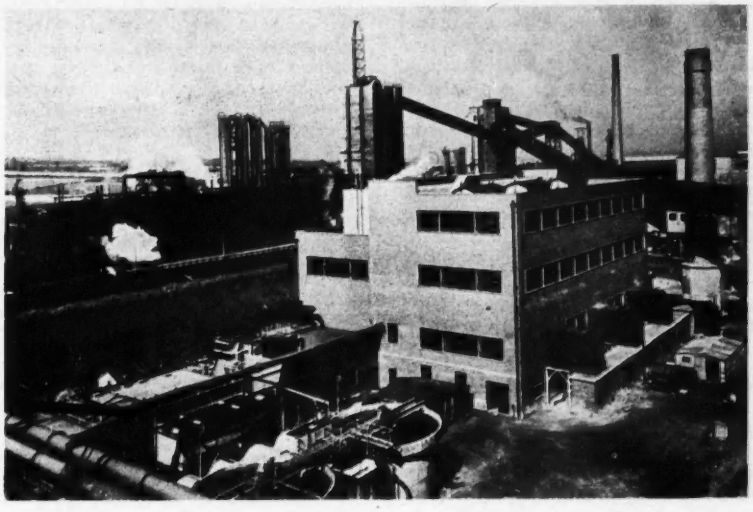
Primary products to be produced by the plant are: 650,000 tons coke (for both the blast furnace and the domestic and industrial markets; 50,000 tons crude tar; ammonia products consisting of 8,500 tons sulphate of ammonia, and 4,000 tons concentrated ammonia liquor; 5,000,000 gallons of crude benzole; and 19½ million cubic feet of gas per day for sale.

The whole undertaking has been constructed on the most modern lines, incorporating the latest devices for carbonising, which is carried out under the most favourable conditions with the maximum prevention of atmospheric pollution.

Extensions at Manvers were designed to replace the equivalent capacity within the North Eastern Division of the National Coal Board at six small coking plants which had reached the end of their useful life. These plants were permanently closed down in 1956 and 1957.

When the NCB took over Manvers Main there were 45 ovens and ancillary plant. Though not unduly old, the batteries had suffered under arduous war conditions, and it was decided to rebuild them. In order to maintain gas supplies all building had to be carried out in stages. The first stage was the building of 17 new Simon-Carves compound ovens; then the 15-oven battery was rebuilt, after which the 30-oven battery was remodelled as two blocks of 13 and 14 ovens respectively, and an additional block of 12 new compound ovens was added. Rebuilding was finished in 1953. On the new site of Manvers a new battery of 66 ovens was built in two blocks of 33. The old site plant has a throughput of about 1,320 tons of coal a day and the new battery ovens a throughput of 1,570 tons a day.

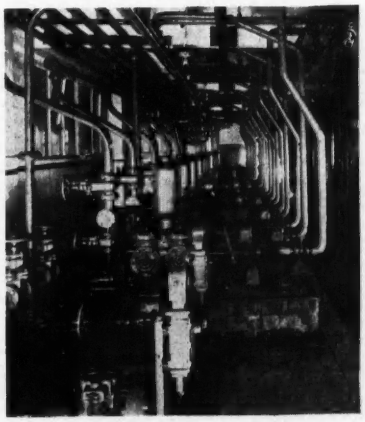
The proposed colliery development scheme called for a central coal preparation plant at Manvers to heat all the coal from Manvers and three nearby collieries. As estimated output of saleable coal from this plant was 12,000 tons a day, including a large tonnage of coking smalls, and as the plant was well placed with respect to the gas grid, the carbonising capacity at Manvers was increased to a throughput of 3,000 tons of coal a day, thus making Manvers Main NCB's largest coking centre. High, medium and low rank coals are treated, these being blended as required.



Power house and water treatment plant in foreground with 66-oven battery in background

This large installation, it was decided, justified its own self-contained steam and electric power plant. Process stream for the by-products plant is obtained by using back-pressure turbines as prime movers.

Owing to lack of space on the old site, a new by-products plant was built on the new site to handle the gas from the new 66-oven battery and from the rebuilt 13-oven and 14-oven batteries on the old site. The foul gas mains from the two latter join the foul gas mains of the 66-oven battery at the inlet to the primary condensers. Thus the new by-products plant receives the gas from the carbonisation of about 2,000 tons of coal a day, leaving the old by-products plant to handle a slightly lower gas volume than previously.



Interior of benzole pump house

The old plant comprises primary condensers, exhausters, detarrers, ammonia scrubbers and benzole scrubbers. Gas for heating the ovens on the old site is taken from the outlet of the benzole scrubbers via two Askania governors. Surplus gas enters the outlet main of the new by-products plant. Liquor from the ammonia scrubbers is worked up in a concentrated ammonia liquor plant built on the new site by Chemical Engineering Wiltons Ltd., a Simon-Carves subsidiary.

At the new by-products plant are primary condensers, exhausters, detarrers, semi-direct separators, direct secondary coolers and benzole scrubbers. At the point where gas from the old site is received an existing gas holder is connected to the main to act as a balance holder; the main divides into two branches, one of which delivers heating gas to the 66-oven battery via an Askania governor while the other delivers surplus gas to the final naphthalene washers. From the outlet of these washers the gas is again divided: About 4 million cu. ft. per day is pumped unpurified to neighbouring towns for the Gas Board; the remainder is boosted through tower purifiers and returned to the compressors which deliver to the gas grid. Provision has been made for dilution of all surplus gas by producer gas, although the producers are not yet installed.

In the primary condensers (two working and one as standby) tar-containing liquors are electrostatically precipitated. Tar runs to seal tanks and is then pumped to depositors where it mixes with condensates from condensers. There are five vertical water-tube condensers (one spare and room for one more) working in parallel. The liquor here contains 0.4 per cent free ammonia. Hot water from these condensers circulates to cooling towers, (corrosion has not been noted as

the river water used is treated and chlorinated to avoid formation of algae).

The detarrers are of standard Simon-Carves tube type with slow moving mechanical scrapers. Liquor from here goes to the ammonia still, and the gas passes to two saturators, one of which is spare.

The liquor still is located near the concentrated ammonia liquor plant, which, although located on the new site, handles the liquor from the ammonia scrubbers of the old by-products plant; a vapour line carries the still vapours to the gas main at the inlet to the saturators. Both stills are served by a single liming plant.

Lime is transferred to the hopper on the burning plant from storage bays underneath. Lime (as milk of lime) enters the mixing chamber which is part of the still. Ammonia, 21 to 22 per cent strength, is freed. Waste liquors from the NH_3 still containing 0.02 per NH_3 is used to quench coke.

Ammonia gas preheated to 65° to 70°C is fed over to the saturators into 5 per cent H_2SO_4. Ammonium sulphate crystals form and are elevated to a settling cone feeding either of two Watson Laidlaw horizontal centrifuges, from which the salt is conveyed to a Dunford and Elliott dryer in the salt store; the dried salt is elevated to a hopper, from which it can be lagged or loaded by belt to wagons or stock. Recovery from stock is by belt conveyor.

Gas from the saturators goes into a baffle where it is sprayed to remove acid and then enters the direct secondary cooling towers, of which there are two in series, a naphthalene washing section being included. The gas, cooled to 30°C, passes to three benzole scrubbers in series; some naphthalene is 'shocked' out here and is drawn off by hand paddles. The scrubbers in the towers have wooden grid fillings, and the washing medium is creosote oil. The benzolised oil is pumped to the crude benzole plant which is discussed in more detail below. For every 100 gallons of benzole produced, a make-up of 10 gallons of oil is required.

The gas handling plant on the outlet of the benzole scrubbers is common to both by-products plants, and the heating gas for the batteries is taken from this main, to which the balance holder is connected; a connection is also taken to a gas bleeder mounted on the service bunker of the 66-oven battery.

Surplus gas passes to two static ring-packed naphthalene washers in parallel; these have washing chambers with corresponding circulating pumps. The washing medium is gas oil, which is regenerated in a plant adjoining the washers. In time the dilution gas main will be connected to the outlet of the naphthalene washers, and provision has been made for automatic regulation of the calorific value of the diluted gas.

From the naphthalene washers, the greater part of the gas passes to two blowers (one spare) located in the exhauster house. These blowers deliver the gas to six Holmes tower purifiers, which are said to be the largest ever installed in this country. They are each 78 feet high and 29ft. 6in. in diameter, and use iron oxide. This installation is complete with charging and discharging apparatus and plant for making up and storing fresh iron oxide charge. A tower can be changed and got back into the gas stream in 12 hours.

The oxide is worked up to sulphur to 50 per cent basis and will be sold as such. To break up the oxide, a prototype plough is used.

Sulphur content of the five different coals passing to Manvers varies from 1.3 to 2 per cent. A blend of the coals usually has a sulphur content of 1.4 to 1.5 per cent and the coke resulting, a sulphur content of 1.2 to 1.3 per cent. There is thus some 0.2 per cent going into the by-product stream.

From the Holmes purifying towers, the purified gas passes via a Connersville gas meter to the four compressors installed so far which deliver to the gas grid. Each compressor has a capacity of 6 million cu. ft. per day. The unpurified gas for the neighbouring towns is taken off the inlet to the purifier boosters and passes through its own Connersville meter to either of two compressors of 4 million cu. ft. per day capacity.

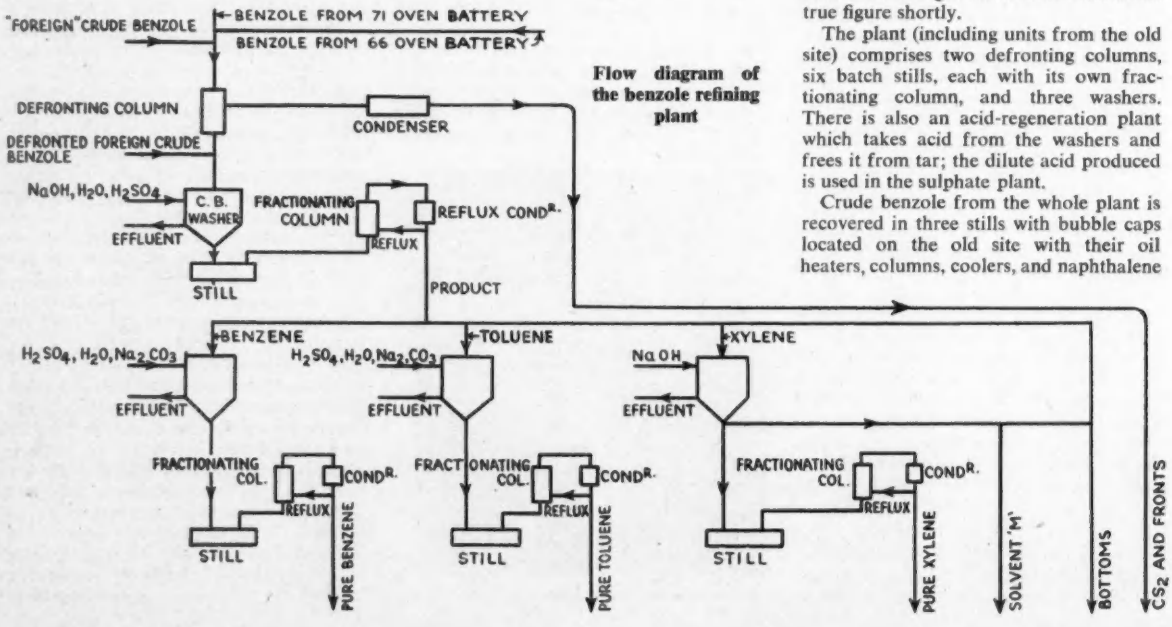
Large Benzole Refinery at Manvers Main

THE very large benzole refining plant at Manvers is the result of many years of development. Benzene and toluene were first produced at Manvers during the first world war. After this the plant only made motor spirit, but during the last war, the manufacture of pure products was resumed and a steady market, based on the high quality of the products, was built up. With the extension of the carbonising capacity of the Manvers plant, an opportunity was provided to develop this market and to achieve the utmost economy of operation by concentrating refining at one large plant.

Layout of the plant is on the most up-to-date lines and embodies many improvements suggested by the experience of the NCB divisional staff and of Simon-Carves. In the final purification stage it is of the batch-working type, but is semi-continuous for its one-working plant. Original capacity of the plant envisaged was 5 million gallons of crude benzole a year, but the plant has now been stepped up to 7 million gallons a year, and it is believed that 9 million gallons will be nearer the true figure shortly.

The plant (including units from the old site) comprises two defronting columns, six batch stills, each with its own fractionating column, and three washers. There is also an acid-regeneration plant which takes acid from the washers and frees it from tar; the dilute acid produced is used in the sulphate plant.

Crude benzole from the whole plant is recovered in three stills with bubble caps located on the old site with their oil heaters, columns, coolers, and naphthalene



Flow diagram of the benzole refining plant

trays. Due to the size of the kettle employed, one still can take up to 20,000 gallons, and the largest still 30,000 gallons of crude benzole. The residue from these is used as boiler fuel and is sold. The crude benzole obtained is treated in the defronting columns to remove carbon disulphide and low heating hydrocarbons are reduced to 0.3 per cent. The benzole is then fed through a Rotameter into a Holmes-Taylor column, packed with testing rings (ceramic) 1 inch in diameter. The column head is controlled by a defamator. Forerunnings, which contain 30 per cent CS_2, are allowed to pass to a condenser.

Defronted benzole passes to cooler and then to storage. It is then ready for further treatment. It is washed with caustic soda to remove mercaptans and other sulphur-containing compounds, then with dilute (once-used) acid before passing to the primary stills for distillation. These produce either motor spirit or semi-pure products. Motor spirit is run to storage tanks, while the semi-pure products are washed again with storage acid before re-distillation in the secondary stills.

Since the plant started in May 1956 the whole of production has been pure benzole, toluole and xylole to NB and NBS. The pure toluole is all of nitration quality, the xylole of 2/3° quality, with small quantities of 3/5°.

To produce pure toluole new 90's toluole is treated by washing with 96 per cent H_2SO_4, and after neutralisation is distilled. Crude xylole is subjected to a caustic soda wash and then to distillation to produce fractions required.

Carbon disulphide is sold as a product. Manvers had hoped to use this product for its cyclopentadiene content and an attempt has been made to burn it to make sulphuric acid. However, the CS_2 is being sold to Yorkshire Tar Distillers Ltd. where it is eventually disposed of to be turned into insecticides.

The plant is fully instrumented and controllers are used whenever appropriate to regulate the stills and columns. Pipe lines are painted according to the standard colour code for easy identification. Provision is made for heating the pipe trenches of the benzole lines to prevent solidification in cold weather. Complete facilities are provided for handling incoming and outgoing products and chemicals, and there is a built-in fire-fighting installation. A filter system in the still house takes away benzole vapour. All storage tanks are mounted inside lined walls, and permanent foam lines run from the fire pump house to the various units. The whole plant is self-contained in that it has its own offices, laboratory, workshop, welfare building, and cooling water circuit.

The process steam supply has been arranged for maximum economy operation. Steam at 140-150 p.s.i.g. and 500°F is received from the back-pressure turbines in the Manvers plant power station and passes through a de-super-heater before entering the heating units of the stills. Low-pressure steam at 15 p.s.i.g. is derived from the exhausts of the reflux and circulating pumps on the plant and is used as direct steam in the defronting columns and acid regeneration plant; it is also used in a special heater which heats the condensate used in the anti-freeze coils in the pure benzene tanks. Any surplus condensate is added to the clean water circulation system which supplies the condensers via a water-cooling tower.

Water Treatment Plant

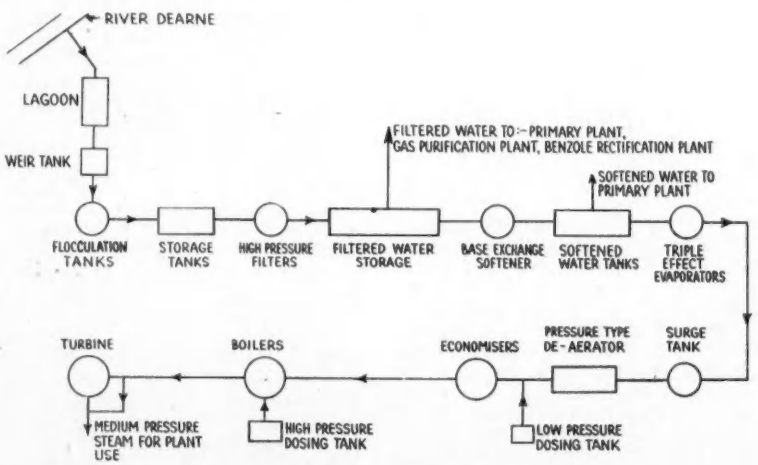
AT Manvers, river water, which is used in 'closed circuit', goes through a water-treatment plant before going to the boilers, together with filtered water and soft water to the coke oven plant.

First stage in the treatment of the river water is the use of aluminium sulphate as flocculating agent. The water is pumped downwards through anthracite filter beds. (At intervals the beds are back-washed, the back-wash going to the river.) The filtered water passes to the base exchange softeners installed by Boby's. At the present time, the plant has a problem on hand regarding detergents which are coating the ion-exchange resin.

Three softeners are available, two in use and one as stand-by. Some 32-33,000 gallons of water pass through each softener in between regeneration. A dissolved oxygen residue of up to 0.004 p.p.m. is allowed, this residue being continually checked by a Cambridge dissolved oxygen meter of the electrochemical type. The softeners are automatically controlled, the controller cutting out a softener which requires regeneration and instituting lime washing while at the same time starting up the stand-by. Water samples are continually taken from the softener.

Filtered and softened water passes into the triple-effect steam-heated Boby evaporators then to second effect evaporators. Distillate passes through a deareator by vacuum, and carbon dioxide and oxygen are removed before the water is ready for use in the boilers.

From the deareator the water passes to a balancing tank. Steam from the boilers (at 625 p.s.i.) is used on the turbo-alternators passing out from these at 150 lb. p.s.i. At this pressure the steam goes to the by-products plant. High pressure steam taken to the exhausters is taken off at 15 lb. p.s.i. and used for open steam distillation heating and steam heating.



Water and steam flow diagram at Manvers

Contractors and Sub-Contractors

Simon-Carves Ltd., Stockport (main contractor): Coke ovens and by-products plant, boiler and power plant, benzole refinery, and electric detarrers. *Palmers-Hebburn Co. Ltd., Hebburn-on-Tyne:* Steelwork, primary gas condensers, benzole scrubbers and secondary gas coolers. *Harringtons Ltd., Wolverhampton:* Tar catch tanks. *Belliss and Morcom Ltd., Birmingham:* Gas compressor, aftercoolers. *W. C. Holmes Ltd., Huddersfield:* Defronting plant. *R. and J. Dempster Ltd., Manchester:* Gas washers, tanks, gas holder. *Watson Laidlaw and Co. Ltd., Glasgow:* Centrifuges. *Dunford and Elliott Ltd., Sheffield 9:* Salt dryer. *Wright's Forge and Engineering Co. Ltd., Tipton, Staffs:* Gas heaters, condensers, benzole rectification stills, tanks. *H. Broadbent and Son Ltd., Ashton-under-Lyne:* Ammonia stills, crude benzole stills, crude oil coolers, fractionating columns. *J. and J. Horsfield Ltd., Dewsbury:* Oil heater for naphthalene scrubber, crude oil heaters. *Yorkshire Engineering and Welding Co. Ltd., Bradford:* Vent scrubbers. *W. Christie and Grey Ltd., London:* Benzole washers. *Peter Brotherhood Ltd., Peterborough:* Cooling towers. *Halchett and Co. Ltd., Hyde, Cheshire: Oxley Engineering Co. Ltd., Leeds 10:* and *Towler and Son Ltd., London E15:* Tanks.

W. C. Holmes and Co. Ltd., Huddersfield (main contractor): Gas purification plant. *Newton Chambers and Co. Ltd., Thorncliffe, Sheffield:* Tower and container steelwork. *'Chisarc' and Shell 'D', Liverpool* and *J. Holst and Co. Ltd., Leeds:* Oxide shed.

W. M. Johnson and Sons Ltd., Leeds: Oxide handling equipment. *Mitchell Engineering Ltd., Peterborough:* Equipment.

Gibbons Bros. Ltd., Dudley: Gas dilution plant. *Sturtevant Engineering Co. Ltd., London EC4:* Air and gas fans. *The Bryan Donkin Co. Ltd., Chesterfield:* Valves. *Westwood and Wright Ltd., Brierley Hill:* Gas valves.

Wilton's Chemical Engineering Co. Ltd., Horsham: Concentrated ammonia liquor stills.

New Dumfries Laboratory

North British Rubber Co. Ltd. have opened an enlarged and modern laboratory unit at their Heathhall, Dumfries, factory to handle the increasing work which is concentrated at this plant. The factory is now self-supporting in respect of technical personnel and equipment. Among the newer products developed is a new type of carpet underlay, introduced a few weeks ago. A new type of plastics flooring will be introduced at Heathhall early next month.

Analytical Review

DIVALENT SILVER AS AN OXIDIMETRIC REAGENT

THERE is a certain fascination associated with the use of solutions of metals in unusual valency states as titrants in oxidimetric analysis, which has led many chemists of international repute to investigate such reagents. The major difficulty connected with these titrants is their instability. Sometimes it is possible to store the reagent under pH conditions which favour stability and use it under conditions where its reactivity is more marked. Alternatively, the aquo-ion may be stabilised by complex formation. Naturally such stabilisation weakens the oxidising or reducing power of the ion, but again, alteration of pH conditions frequently solves the problem. Such methods have been used for Fe(VI)(1), Cu(III)(2), Mn(III)(3), U(IV)(4), etc. However, such devices are not always successful.

The technique of coulometric titration generally permits unstable ions to be generated electrolytically *within* the test solution so that the problems associated with storage of reagent solutions do not arise. However, even such a device sometimes fails. Thus Meier and Swift(5) did not find it possible to use the coulometric method for Ag(II) because this powerfully oxidising ion attacked the water molecules of the solvent medium and did not yield a rapid response with the amperometric system used for the end-point detection. However, the use of Ag(II) has recently been re-investigated by Davis and Lingane(6). These authors have found that 100 per cent efficiency of generating Ag(II) using a platinum or gold anode is only obtained in cold 3.7M nitric acid. In other mineral acids the titration efficiency was less than 90 per cent due to reduction of Ag(II) ions by water. The action of nitric acid is attributed to the formation of a dark brown silver(II) nitrate complex.

Higher Current Efficiency

A decrease in temperature to *ca.* 0°C enhanced the stability of the Ag(II) ion and favoured a higher current efficiency. The current efficiency was also improved by working at the maximum permissible current density since the slope of the current-potential curve for the oxidation of Ag(I) is greater than that of the curve for the oxidation of water. In this connection, gold was preferred to platinum as the anode material because of its higher oxygen over-potential.

The slow response of the platinum micro-electrode used for amperometric detection of the end-point, which had been observed by Meier and Swift, was confirmed by Davis and Lingane. Further investigation of this phenomenon by the latter workers revealed that previous oxidation of the electrode surface produced an indicator electrode which gave an immediate response to Ag(II) ions. The presence of this oxide film was ensured by treatment of the electrode with Ag(II) ions before use.

The utility of coulometric titration by means of Ag(II) was demonstrated by the determination of a variety of oxidisable substances e.g. oxalic acid, cerium(III), arsenic(III) and vanadium(IV). Manganese (II) and chromium(III) were not amenable to such treatment because they reacted slowly with Ag(II) ions. They were determined successfully by generation of excess Ag(II) in their presence and back titration of the unreacted Ag(II) with standard ferrous solution. Substances which reduce nitric acid were determined successfully when precautions were taken to prevent the escape of the titratable nitrogen oxides.

This article by Dr. T. S. West features:

1. **The use of divalent silver as a reagent in coulometric titrimetry.**
2. **A new derivative of ethylenediamine-di-acetic acid used as a selective reagent for the spectrophotometric determination of iron.**
3. **Some recent developments concerning complexometric indicators for use with EDTA.**

New Complexone-Type Reagent. The synthesis of a derivative of N,N′-ethylene diamine di-acetic acid having an *o*-hydroxyphenyl group in place of one of the methylene hydrogens in each acetic acid group has recently been reported(7). The reagent is of interest because of its powerful chelating action on Fe(III) and the intense colour of the compound so formed.

Underwood(8) has now applied this reagent — ethylenediamine-N,N′ di(o-hydroxyphenylacetic acid)—to the spectrophotometric determination of iron(III). The iron solution shows a broad absorption-band at 470 mμ, which shows constant absorbance over the pH range 2–9. A large excess of reagent is not required for colour formation and it is in fact possible to titrate the iron spectrophotometrically with the reagent. This technique eliminated the interference of extraneous coloured substances which do not react with the reagent since only relative measurements of absorption are required for the purposes of titration. The colour of the Fe(III) chelate is indefinitely stable and is formed instantaneously if the reagent is added *before* the buffer (pH5). Maximum colour formation is delayed somewhat if the buffer is added before the reagent probably because of the partial hydrolysis of the Fe(III) ion. The reagent solution has a measurable blank which increases over a period of several days. Consequently it is recommended that a fresh reagent solution should be prepared each week. Cobalt and chromium interfere seriously with the method; uranium, thorium and nickel interfere slightly when present in moderate amounts. The recommended procedure was applied to the analysis of iron in an aluminium alloy.

The reagent is fairly selective for iron(III) in its action, but in solutions of low pH it appears to be less strongly chelating than EDTA. The complexes formed with most other metals are on the whole much weaker than those formed by EDTA; the alkaline earths are practically unaffected by it(9, 10).

Complexometric Indicators. Cheng(11) has reinvestigated the problem of titrating copper in admixture with other metals using EDTA with PAN, as indicator. Previous work(12) has indicated that although (1) the zinc complex of EDTA is weaker than that of copper and (2) zinc does not form a coloured complex with PAN (while copper does) it is not possible to titrate copper in the presence of zinc. In this new paper, it is shown that metals such as zinc and cadmium can be titrated at pH > 5 using EDTA and PAN. Copper does not interfere if the solution is treated with excess of thiosulphate, which effectively reduces and masks copper ions. The copper was estimated by difference after determining the total of copper and zinc in unmasked solution.

It is the experience of many workers that the Cu-PAN-EDTA end-point is most unsatisfactory and it is of interest to note that in this paper Cheng confirms this, but reports that a sharp end-point may be obtained if a small amount of alcohol, dioxan or dimethylformamide is added to the solution. Care is necessary in adding the indicator and in controlling the excess of thiosulphate.

Specific Copper Indicator

Fast Sulphon Black F has recently been proposed by the writer and his co-workers (13) as an indicator for the complexometric titration of copper. The indicator is virtually specific. Nickel is the only other ion to form a coloured product under the recommended conditions, but the titration of nickel is not practicable because of slow reaction of the nickel-indicator complex with EDTA. The pale blue to bright green end-point with Fast Sulphon Black F and copper is very sharp. Other metals can be determined indirectly by adding a known amount of copper to their solution and titrating in the normal way.

Some new colour reactions of phthalein complexone with heavy metals have also been reported(14) and its application to the titration of manganese and cadmium has been described. The same group has investigated the indicator action of several commercially available hydroxy azo dyes for use with EDTA(15). Solochrome Black 6B was found to be superior to Solochrome Black T on account of the quality of the Mg_2U/EDTA end-point and the greatly improved shelf life of the indicator solution.

(*Continued on page* 684

Instrumentation Review

Process Control Instruments are Challenge to Industry

TOPICAL talking points in analytical instrumentation include gas-phase chromatography and spectroscopy, with special attention on the incidence of nuclear magnetic resonance. The steady development of spectrophotometers with still higher sensitivities continues to attract interest and the advance of polarographic instrumentation, on the broad front of analytical research, teaching and student models, prepares the ground for more general introduction of the polarographic technique.

The development of process control versions of standard laboratory analytical tools is presenting a challenge to the industry that is being tackled with enterprise and ingenuity, and the increasing number of special purpose instruments on the market reveals the progress being made in applying originality to the problems besetting the manufacturers as well as the research workers in university and industry.

Progress in gas chromatography is exemplified by the versatile multi-purpose six-column instrument developed by the Chemical Inspectorate, Ministry of Supply. Designed for use in laboratories in which it is desired to analyse a wide variety of materials as rapidly as possible, the instrument is built on the unit principle, each unit accommodating two columns. Each column is housed in a separate oven and has its own controls for gas flow, temperature, detection and fraction collection. Two recorders, housed separately, can each be connected at will to any of the columns, and the instrument as a whole makes it possible to maintain a number of columns containing a variety of liquid phases under a wide range of operating conditions, each being ready for instant use when required.

Infra-red Spectroscopy

Derivative infra-red spectroscopy described by Singleton and Collier in 1955 (1) has found practical application in the work of Collier and Panting at Imperial Chemical Industries Ltd. alkali division, in determining methyl groups in polythene and Martin has presented interesting possibilities using multiple differentiation.

These developments together with the technique and applications of nuclear magnetic resonance were discussed at length during the recent conference on molecular spectroscopy organised by the hydrocarbon research group of the Institute of Petroleum (27 February), the proceedings of which will be published shortly by Pergamon Press. The development of a British nuclear magnetic resonance spectrometer is awaited although the pioneering work of Varian Associates is recognised.

On the other hand the introduction into this country of competitive infra-red spectrometers, and, shortly, of inexpensive polarographs is viewed with interest and curiosity, since the photographic recording method adopted for the polarograph was replaced in this country by more popular methods some years ago. The influx of spectrometers, however, coincides with the introduction of further British manufacturers into this expanding field of instrumentation.

Ammonia in gases. The Towers electrolytic gas analyser was designed by Imperial Chemical Industries Ltd., Billingham division, to estimate ammonia and other gases over the range 5-100 p.p.m. with an accuracy of ± 2.5 per cent.

Calcium in liquids. The Eel Titrator is particularly suitable for the determination of calcium using a colour indicator. The optical density is indicated on an external galvanometer.

by
W. J. Parker

Special purpose analytical instruments are increasing in number with wider ranges of applicability, greater sensitivity, accuracy, specificity or discrimination, and speed of response, and with the ability to work batchwise or continuously, and to indicate, record or control.

This article is the first of a monthly series, to be run in conjunction with Dr. West's Analytical Review, in which Mr. Parker will review new developments in these instruments.

Carbon dioxide in flue gas. The Cambridge carbon dioxide meters are calibrated from zero to 20 per cent, and operating on the katharometer principle they provide an accuracy within 0.5 per cent carbon dioxide. The instruments operate continuously and may indicate or record at any distance from the metering unit.

Diesel fuel in lubricating oil. The EMI oil contamination meter, based on the controlled oxidation of contaminants, permits their measurement batchwise, in the range 1 to 15 per cent, with an accuracy of ± 1 per cent, at the rate of one measurement every 5 minutes, the instrument being self-filling, emptying, and cleaning. The instrument is direct-reading.

Hydrazine in boiler water. A method has been developed which enables the Lovibond Tintometer to be used batchwise for this determination.

Hydrogen in gases. An instrument has been developed by the scientific department, North Western Division, National Coal Board, which permits the detection of hydrogen down to 50 p.p.m. Based on gas chromatography, the instrument will determine hydrogen, with a precision of ± 0.005 per cent, in samples containing 1 per cent, and facilities for measuring up to 10 per cent hydrogen are provided. The instrument operates batchwise on 10 ml. samples of gas, and the hydrogen concentration may be indicated as a percentage on a galvanometer or recording potentiometer.

Magnesium in liquids. A titration absorptiometer designed by Dr. F. D. Stott and recently demonstrated by Baird and Tatlock (London) Ltd. eliminates the need for calculations to allow for different volumes of sample and standard solution at the balance point. The instrument operates batchwise on a sample volume of 5 ml.

Oxygen in gases. The Hersch oxygen meter is designed for the continuous measurement of traces of molecular oxygen in other gases. The ranges covered are 0-10 and 0-100 p.p.m. by volume. The instrument operates continuously on the galvanic principle with a feed rate of 22½ litres per hour, and provides a continuous indication of the oxygen content of the gas under test on a meter, recorder or recorder-controller. An accuracy of ± 5 per cent and a speed of response of 2½ minutes, for a 90 per cent adjustment to a change of oxygen concentration, is reported.

pH of solutions. The Doran Universal pH Meter enables readings of pH to be made to 0.001 pH units. Temperature compensation can be either automatic or manual as required.

Quinine sulphate in liquids. The Electronic Instruments direct-reading fluorimeter gives full-scale deflections equivalent to concentrations of quinine sulphate of from 1 part in 10^6 to 1 part in 10^8 on five ranges. The accuracy of discrimination is to 2 parts in 10^{10}. The instrument is direct reading and the Model 27 was developed in conjunction with Boots Pure Drug Co. Ltd.

Sodium in liquids. An ultra micro flame spectrophotometer, has been demonstrated by the National Research Development Corporation, which permits the detection of as little as 3×10^{-13} g. of sodium. The instrument operates batchwise, on samples of 50-200 microlitres, and the measurements may be indicated on a galvanometer or automatically recorded.

Tin on tinplate. The determination of tin, and tin-iron alloy, on tinplates by means of a coulometer developed by Research and Industrial Instruments permits the direct reading of free tin and tin-iron alloy contents in g. per sq. m. or other chosen units. The coulometer is based on the same principle as that of Kunz and Willey(2) and was originally developed and described by Monvoisin and le Blanc(3).

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(1) *Chem. and Ind.* 1955, p. 519.
(2) *J. Electrochem Soc.*, 1952, **99**, 354.
(3) *J. Tin. Res. Inst.*, Oct. 1955, No. 33

AUTOMATIC CONTROL IN CHEMICAL INDUSTRY

Development of Instrumentation

DURING the last 40 years, British chemical industry has seen the birth and subsequent development of instrumentation as we know it today. Instrumentation has been necessary to meet quality and price, while the scale of production has grown so that control could not be left to simple indicators, such as thermometers, and human beings.

Early 1900 to 1910 saw the start of the use of thermostats and similar self-acting devices. On/off control only was available until about 1920 and was limited to batch operations of a stable character. Proportional action controllers followed giving throttling actions and extended use of instruments. Subsequently, in 1925 to 1945, controller mechanism developments permitted control instruments to be applied to most existing processes. Thus ICI Billingham division in 1928 had 50 controllers, in 1949 the number had risen to 400 and in 1955 was over 1,200. In general the process design was not changed for the controller was simply 'grafted' on.

Since the early 20's substantially all major oil and chemical plants have been fully equipped with automatic control of variables. The ICI Wilton olefins plant, for instance, has 30 temperature controllers, 70 pressure controllers, 50 flow controllers and 100 liquid-level controllers. One oil refinery alone has 800 flow controllers. In other respects, however, since individual settings are made by the operator in the light of operating requirements, product quality and plant condition, they are not 100 per cent automatic.

Improvements in automation latterly, have been mainly to improve measurement, flexibility and maintenance of equipment.

Economies

Economies from instrumentation in respect of labour and services are well recognised, but it is not always appreciated that instrumentation can reduce maintenance costs. More careful control of temperature and pressure, for example, reduces strain on reaction vessels. Also, it is not always realised that it is not only in the simpler processes that maximum progress has been made. The processes which have benefited are where small continuous reactors have replaced the autoclaves, lined vats, etc., and where intermediates pass from stage to stage without individual isolation.

Economies which instruments have brought in capital outlay are: reduced building size since plant can now be in the open air while the operator remains in front of a control panel; reduction in vessel size as reactions are continuous and require smaller reacting quantities; and reduction of stocks due to intermediates not being isolated.

Cost of automatic control of plant is always of interest. Thus, the cost of equipping boilers and hydroformers at a large refinery with instrument control recently was about £40,000. For a coal preparation plant, the cost was about £15,000 and for coke ovens £20,000. The cost of equipping small plants with instrument controls may be between £250 to £500.

Delving further into the economics of automatic control and instrumentation, it is realised that cost of equipment varies with the wide range of differing duties to be performed. For example, a direct acting refrigeration thermostat can cost £7 15s, a simple blind air pilot-operated pressure control £60, a recording temperature controller, air pilot-operated, with direct connected liquid expansion system £160; this latter with pneumatic transmission would cost £230, while a ratio flow recorder controller could cost £450. Size, scale and nature of the plant affects only valve size and materials.

Based on notes provided by

A. H. Isaac, B.Sc., A.M.I.Chem.E.

(Manager, Sales Engineering Dept., Foxboro-Yoxall Ltd.)

The total cost in relation to plant depends, of course, mostly on plant size, materials and working pressure. A general figure is 5 to 8 per cent of plant costs excluding site preparation. Perhaps a better picture is cost based on value of annual output. P. K. Simpson, Albright and Wilson, gives £50,000 worth of instruments on £1 million output, that is 5 per cent. (ABCM Automation Conference 1956.)

As an example of instrumentation economics, let us take pyridine, which is a high value product at about £1 2s 6d per gallon, made in the same plant as naphtha at 5s per gallon.

Production of 125,000 gallons of pyridine per year equals £140,000 per year. The same amount of naphtha equals £32,000 per year. If plant cost £15,000 and instruments £2,500, the outlay is 16 per cent on capital. For naphtha it is 8 per cent and for pyridine 1.2 per cent on annual production. Maintenance and servicing costs must be borne in mind. They will vary, of course, depending on plant condition, number of instruments, location and type. Coverage must also be allowed for consumable spares, power, air supply and preventative maintenance costs.

The annual charge must also cover a depreciation figure, which must be offset against savings by installation of automatic control.

For a small chemical plant Simpson lists capital cost of instrumentation and installation at £2,000. Annual operating costs allowing 12½ per cent for depreciation are suggested at £160, that is, 30.5 per cent. With larger plant such as a catalytic cracker for gasoline production capital cost of instruments and installation may be £56,000. Annual operating costs allowing 12½ per cent depreciation would be about £14,893—that is 26.8 per cent.

Even allowing for these figures favourable balances can be achieved. Annual cost on a £30,000 plant operation has been assessed as shown in table below.

For efficiency it is important that automatic control is the responsibility of one department, with suitable premises and equipment. The cost of such a section varies. According to one authority the cost is £15,000 instruments per one man with a workshop valued at £3,500. Another authority quotes one man to £8,000 on shift work, and £20,000 for the workshop for a complete refinery.

It is perhaps fitting that the reasons for the use of automatic controls should be considered. The use of instruments on any plant is a means to an end—namely of obtaining effective operation of the unit under optimum operating conditions.

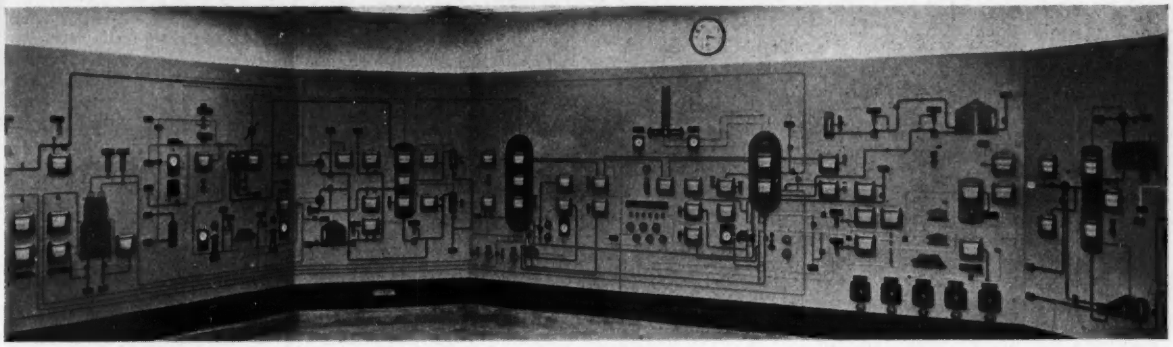
Product Control

Product quality and quantity control: Under this head can be placed (a) consistency of operation, thereby improving yield and process repeatability; (b) momentary unbalance of values can destroy a product as, for example, charring during polymerisation of synthetic rubber; (c) the serious effect of sudden changes of variables, e.g. reflux on distillation columns can upset quality; (d) complex plants which are continually subject to varying disturbances require continual correction. The automatic controller in such an instance is tireless, continuous and analytical, and high precision is possible.

Economic control: There is no 'playing safe' with excess reactants when automatic control is adopted. Fewer spoilt batches occur on recycle products, while the proportions of reactants are better regulated. On the manpower side, when automatic control is complete, few shift operators are required. In the average oil or chemical plant, valued at £2m., the available

Costs based on 8,000 working hours per annum (according to P.K. Simpson)

With Automatic Control	£	*Without Automatic Control*	£
1 process operator at 4s 7d/hr. for 30% of plant operating time	550	1 process operator at 4s 7d/hr.	1,830
Depreciation of instruments on initial cost of £2,000 at 12½%	250	Additional nitrogen usage	150
Instrument maintenance—labour and materials	300	Additional steam usage	200
Electrical power	40		
Depreciation and maintenance of compressed air services	20	Additional plant cost £3,500, depreciation at 10% of additional plant items	350
	£1,160		£2,530



Comprehensive control panel in an isolated control room. Hydroforming plant at Esso Co.'s Fawley refinery (Foxboro-Yoxall Ltd.)

skill of operators, as well as wage rates, matters.

Fuel and power can represent very substantial items; thus, 8 per cent carbon dioxide instead of 12 per cent gives 30 per cent more coal to a boiler. Steam wastage to traps can be avoided, as also the use of excessive pressure. Indirect saving is obtained by working to closer limits. As an example, R. Clare of the National Industrial Fuel Efficiency Service (North Western Area) might be quoted. Tests carried out on steam-heated liquor tanks using recorders to measure temperature and steam flow enabled the steam consumption to be related to the temperature at which the tanks were maintained. Examination of these results showed that an increase of 10°C above the working temperature resulted in an increased steam flow of 2,240 lb./hr., equivalent to 1,060 tons of coal a year, or about £7,000 per annum, that is manual control $\pm 1\frac{1}{2}$°C loses 300 tons of coal per year compared with $\pm\frac{1}{2}$°C with automatic control.

Maintenance of optimum operating conditions ensures maximum throughput. In this instance, differential pressure control across batch columns can reduce batch time by 20 per cent to 30 per cent, and guards against priming. Pressure control on fans and blowers permits operations close to critical characteristics for plant showing discontinuities, e.g. air driers or filters in parallel with changeover, and recirculation control on driers.

With regard to capital and initial investment, increased throughputs or qualities are reflected in fewer plant units. In some cases four distillation units automatically controlled can carry out the work of five uncontrolled with a consequent saving of £10,000 to £15,000. Precise control will permit the design of pressure vessels to be closer to working values so making lighter construction possible. Demand for intermediate storage capacity can be reduced, while permitting fully continuous plant with high throughput rates which would be uncontrollable by hand.

Instruments in such cases can provide a noticeable capital saving. A gas board has found that the use of instruments costing £2,500 in place of a gas holder for pressure control of excess gas during coke oven reversal, provided a capital saving of tens of thousands of pounds.

Safety precautions: In the plant itself, automatic control can protect against excessive operating conditions which can cause premature deterioration or damage, with consequent shutdown. Dangerous deterioration of plant can interfere with other plant operations, upsetting production and maintenance schedules.

Control limits differ in the precision required. Some demand very critical limits as, for example, p.v.c. polymerisation which will char if overheated. A distillation column may take 24 to 36 hours to restart and during this period, products are off specification. In such cases automatic control assists in the rapid return to stable conditions.

Personnel: There are plants which process toxic, corrosive and inflammable fluids, or in which a dangerous mixture can be formed under certain conditions. In some plants exothermic reactions must be kept within closely defined limits. It can be considered standard practice in such cases as instanced above to provide an instrument installation for the protection of personnel and plant.

Such installations can be divided into two classes (a) where a visible and audible warning is given when a variable process exceeds or falls below a preset value. Corrective action is then left to the operator. Or (b) where in addition to a warning, safety action is automatically initiated to put the plant in a safe condition. Such an installation also minimises the effects of human error.

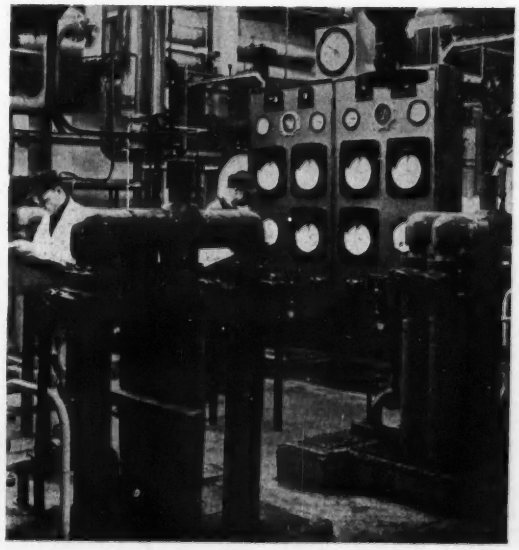
Without instruments large-scale processes such as handling of chlorine, ethylene oxide, fluorine or tetraethyl lead, would be hazardous to operators. Possibly the most striking example of automation is to be seen in the processing and separation of radio-active materials.

Problems of automation: a somewhat dangerous attitude, partly due to the national press, has developed that automation implies a push-button control only. A particularly costly and complicated problem besets the company which wishes to jump 15 years from non-automatic control to fully comprehensive automatic control. When estimates are obtained, these prove to be so costly that the company is frightened off.

It cannot be too strongly stressed that automatic control should be carried out in stages. By means of a fairly modest outlay it is possible, as we have seen, to make automatic a few stages of plant operation, and this forms the basis for the development for fully automatic control later on even up to five to ten years.

Companies manufacturing specialised instruments for automatic control can supply equipment which can solve nearly all control problems today. But the manufacturer cannot help if equipment is not properly installed and maintained. Although man cannot compete with instruments that are operating accurately,

(*Continued on page* 684.)



Typical control panel located among the plant units that it serves. Associated Ethyl Co., Ellesmere Port (Foxboro-Yoxall Ltd.)

man is infinitely superior to instruments which are not working correctly.

Instrumentation cannot be relied upon until there is a satisfactory procedure for inspection, cleaning and replacement. The problem of maintenance is much more difficult and is undoubtedly one of training. There is, unhappily, a very real lack of trained staff. Good instrument engineers are few and far between. Manufacturers of automatic control instruments are fully aware of this pressing problem. In the case of one company their school is training something like 150 men a year from the process industries, including instrument mechanics, fitters, and some senior instrument engineers.

Apart from training on the works or with manufacturers, normal channels of education are available. Local technical colleges will run courses for instrument mechanics if the local industries guarantee a demand and ask for them and where necessary co-operate in the release of men for teaching. There are training facilities already available in a number of technical schools and colleges leading to appropriate ordinary and higher national certificates, City and Guilds and other diplomas.

The future: Expansion of instrumentation in the chemical industry has benefited all concerned:—the producer, the customer, but most of all the workers, the men who operate and repair plants and their ancillary equipment.

Several lines of progress are likely to develop in the coming years. Most noticeable will be further development of endpoint analysis instruments with consequent increased plant control. Automatic product quality control will undoubtedly require some years more for development.

Further improvements in the design of electronic equipment for control purposes to provide comparable overall service, flexibility and cost to other industrial instruments will lead to an increased use of this style of equipment. But until better measurement of process variables giving electrical output signals is available, and electrical activated operation of control values no longer involves the present unsolved problems, increase in electronic instruments is likely to be limited.

One other notable problem which so far remains unsolved is the difficulty of measuring the temperature of powder, pellets or extruded plastics sheets.

Despite these problems, there are today, standard modern types of instrument and control equipment for the majority of the chemical industries' requirements. Co-operation between users and manufacturers will undoubtedly lead to the solving of users' problems, and provide the manufacturers with the stimulus they require to develop new instruments.

ICI'S TITANIUM FURNACE PRODUCES LARGEST INGOT OUTSIDE THE US

EUROPE'S largest titanium melting furnace came into operation this month at the Kynoch works of Imperial Chemical Industries Ltd., metals division, Witton, Birmingham.

This is one of three furnaces supplied to ICI by W. C. Heraeus G.m.b.H. (Western Germany) for the production of double-melted ingots up to 4,200 lb. in weight, by the consumable electrode arc melting process. The furnaces were delivered in January and the first 1 ton ingot was produced a little over two months later. Within a few days, an ingot weighing 4,200 lb.—the largest ever produced outside the US—was successfully melted.

The availability of such large ingots offers two advantages:

(1) It widens the scope of fabricating techniques which can be applied to titanium.

(2) It increases yield by decreasing surface/volume ratio.

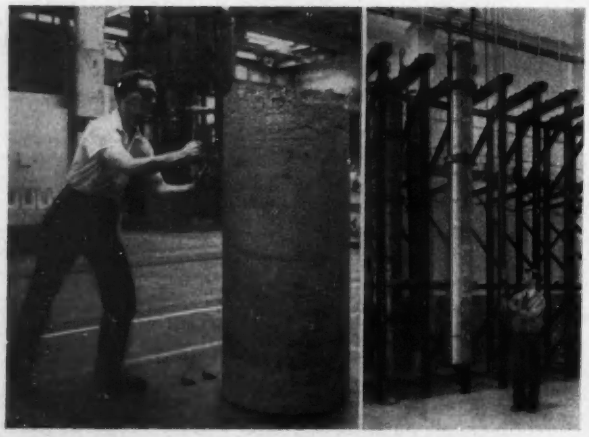
Several interesting features are embodied in the equipment. The melting current employed is higher than has ever before been used for this purpose in Europe, facilitating more complete melting and resulting in ingots of improved homogeneity and better surface quality. The furnace will normally operate with a high degree of vacuum, a pressure of under 10 microns being maintained throughout a melt. Facilities are also provided for melting under a reduced pressure of an inert gas, should this be required.

Particularly useful are features which reduce 'down time' between melts and effect big improvements in furnace utilisation. The first-melt ingot can be withdrawn into the upper part of the furnace and held in vacuum while the larger-diameter crucible necessary for the second melt is fitted. Another allows the second-melt crucible, containing the double-melted ingot, to be sealed by a plate valve and withdrawn from the furnace for cooling, so that the furnace can immediately be prepared for another melt.

The hazards associated with titanium melting are now better understood, and the new installation is claimed to incorporate the most advanced safety measures yet devised. All operations are carried out by remote control and the furnaces are installed in reinforced concrete cubicles affording complete protection. In the control room, optical systems give operators a clear view of the furnace interior throughout the melting process. Other instruments record essential technical data at all stages and incorporate a system of fault indication and location.

It is less than three years since ICI commissioned Britain's first titanium melting plant. Since then, technical knowledge has accumulated so rapidly that the company has twice replaced its entire complement of melting furnaces. ICI are, however, satisfied that furnace development has now achieved stability and that the present equipment will meet all foreseeable requirements for a much longer period.

In 1955, 18 furnaces were needed for an output of 1,500 tons a year; today, three are sufficient to produce over 2,000 tons a year.



Left: The first 4,200-lb. titanium ingot ever to be melted in Europe. The operator is stamping it with identification marks. Right: A 2,100-lb. titanium electrode being lifted from the storage rack for transport to the melting furnace

Harwell Reactor Course

The next UK Atomic Energy Authority standard Reactor School Course for which places are available will begin on 1 September 1958 and finish on 23 December. The first six weeks will be held jointly at Birmingham, Bradford and Salford Colleges of Advanced Technology and the remaining part at the Harwell Reactor School, Atomic Energy Research Establishment, Harwell, Berks.

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PREVIEW OF IEA EXHIBITION

Latest Instrument Developments Shown by Over 250 Companies

OVER 250 companies will take part in the 1958 Instruments, Electronics and Automation Exhibition, to be held at Olympia, London, from 16 to 25 April. The exhibition, which is one-third larger than in 1957, is sponsored by six organisations: The British Electrical and Allied Manufacturers' Association, the British Industrial Measuring and Control Manufacturers' Association, the British Lampblown Scientific Glassware Manufacturers' Association, the Drawing Office Material Manufacturers' and Dealers' Association, the Radio Communication and Electronic Engineering Association and the Scientific Instruments Manufacturers' Association.

In the following pages we review some of the recent developments which will be on show.

Single and Double Contact Pressure Switches

Pressure switches fitted with single and double contacts with almost negligible differential between make and break will be shown by the **Accurate Recording Instrument Co.,** Garth Road, Morden, Surrey. These are claimed to be suitable for both caustic and non-caustic media. Ratings up to 15 amps and both indicating and non-indicating types are available.

Other instruments on show will include standard and differential pressure gauges of the Bourdon bellows and diaphragm-actuated types, temperature indicators, tank contents gauges, temperature recorders and temperature recording controllers, temperature indicating controllers, indicating thermostats and pneumatic indicators and controllers.

Remote electrical tele-reading instruments for local and remote reading of pressure, temperature and vacuum will also be shown. These are mains operated.

Process Control by Analogue Computer

Of interest in chemical process analogues is the servo-driven strip potentiometer unit to be shown by **Air Trainers Link Ltd.,** Bicester Road, Aylesbury, Bucks. These units, it is claimed, permit the rapid setting up of non-linear functions. Thus functions obtained from experimental work can be inserted into an analogue equation without the tedious work of establishing the mathematical equation for the particular curve.

Where flows, temperatures, pressures and other conditions are required to obey known complex relationships and yet vary greatly in overall magnitude, an analogue computer using Air Trainers Link d.c. techniques can be used to control the process. Slow reactions can be studied with analogue networks set up to work on an accelerated time base.

Valve for Control of Radioactive Water

An air operated valve designed for the control of radioactive water at a pressure of 2,000 p.s.i. and temperature of 300°C will be shown by **Alexander Controls Ltd.,** Reddicap Hill, Sutton Coldfield, Warwickshire.

A range of solenoid and pneumatically-operated valves will also be shown, covering many chemical and nuclear applications.

Valves of various types and sizes from ⅛ in. to 6 in. bore will be shown, with bodies and internal trim of varying materials including Monel and stainless steel according to the corrosive properties of the medium.

In addition to the range of standard units suitable for air, gas, water, steam and fuel oils, etc., a new range of three-way and four-way solenoid operated pneumatic valves for operation of diaphragms and air servo cylinders will be exhibited.

Weight Control by Punched Cards

Weighing in automatic production processes is to be demonstrated by **W. and T. Avery Ltd.,** Birmingham 40, by a hopper scale operating in a simple blending process. By means of electric signals, control information is fed to the scale from punched cards and performance data are taken from the scale for production record purposes. The principles employed, while providing a high degree of flexibility, do not impair the accuracy of precision mechanical weighing.

Analytical Pocket pH Meter

Claimed to be the only pH meter of its kind available in this country, the analytical pocket pH meter, with an analytical pH probe unit that combines the glass and reference electrode as one unit, will be featured by **Analytical Measurements Ltd.,** The Quadrant, Richmond, Surrey. Self-contained with batteries in a Bakelite case, the instrument is supplied with novel plastics tubes of buffer KCl solutions.

The meter is scaled from 2 to 12 pH and a simple adjustment gives readings from 0 to 14. Accuracy of 0.1 pH is obtainable. Hearing-aid type batteries provide up to 1,300 hours of operation. The electrometer tube, switch and input connector are sealed in a single unit to ensure freedom from high humidity difficulties.

Grounded samples can be directly measured because there are no external power connections.

Interference Microscope

What is said to be the only instrument of its kind, the Birefringent interference microscope, will be shown by **C. Baker of Holborn Ltd.,** Purley Way, Croydon. It is claimed to show unstained microscopical specimens in brilliant interference colour contrast and to be able to measure their optical thickness. From this information, protein concentration, refractive index, dry mass and total mass of living material can be calculated.

On the Series 4 research microscopes will be shown for the first time the new Triolux condenser. This allows bright field, dark field and phase-contrast illumination to be done with the same condenser. Rapid change from one type of illumination to the other has been achieved while retaining full cone bright field illumination.

Sintered Ceramics

A range of laboratory ware by the Degussit oxide ceramic department of Degussa, Frankfurt, will be shown by **F. S. Bayley, Clanaham and Co. Ltd.,** Brazenose Street, Manchester 2. It will include crucibles, boats, trays, thermocouple protection tubes and insulators. Also to be shown are sintered ceramics in pure aluminium oxide and other metal oxides for the highest thermal, electrical and mechanical needs.

Diaphragm Valves

A new range of diaphragm valves will be displayed in sizes up to 3 in. BSP by **Black Automatic Controls Ltd.,** Corsham, Wilts. They are designed for handling a wide range of industrial liquids, including high viscosity fluids such as grease, wax, etc. The range provides full bore flow. An extended range of pressure and vacuum

Pocket pH meter made by Analytical Measurements

switches will include models suitable for operation at pressures up to 10,000 p.s.i. and those having fully adjustable differential.

Induction Heater

General-purpose induction heater (FA27a) has been introduced by the **British Thomson-Houston Co. Ltd.**, Rugby, for those processes where heating must be confined to a shallow surface layer or which must be strictly localised. Heat energy is said to be economised and heat effect on other parts of the plant is minimised. The equipment, clean in operation, can be included in the production line of modern processes.

Fully automatic, the system gives uniform results without the need for highly-skilled operators. The heater has a continuous output rating of 25 kW and a peak intermittent rating of 30 kW. Output frequency is 500 kc/s and it is designed for operation on a three-phase 50/60 cycles, 380/440 volt supply.

Pocket pH Meter With Combined Electrode

A new, self-contained pocket-sized pH meter of high stability and accuracy is to be shown by **Cambridge Instrument Co. Ltd.**, 13 Grosvenor Square, London SW1. It is intended for works, laboratory or field service where spot checks are called for. The scale, 0–14 pH units, is subdivided into 0.2 pH units and the instrument has an accuracy of ± 0.3 pH. To save space and to simplify operation, the measuring and reference electrodes have been combined into a single unit.

The electrode system is fitted into a plastics container so that small quantities of liquid can be tested without the need for a beaker or stand. The instrument, electrode system and buffer solutions can be contained in a small carrying bag with shoulder strap. A dry cell electrical supply is contained in the case.

Stopcock Lubricant

A multi-purpose stopcock lubricant is to be featured by **Camlab (Glass) Ltd.**, 50 Burleigh Street, Cambridge. It is stated that one grade of lubricant will cover all purposes. It has a range of minus 35–350°C with a high degree of 'spread' over the complete temperature range. In laboratory tests, complete resistance up to and including 60 per cent sodium hydroxide was noted.

The lubricant has been used under high vacuum conditions up to, and including, 10^{-5}, and substances such as titanium tetrafluoride were successfully prepared. Only two organic solvents were found to have any adverse effect—chloroform and chloro-benzene.

Fluid Density Measurement

In the field of fluid density measurement, **Ekco Electronics Ltd.**, Southend-on-Sea, are showing a gamma-ray source to be mounted within a shielded container on one side of the pipe or tank containing the liquid or slurry to be measured. A pressurised ionisation chamber is fitted on the opposite side. Variations in the density of the liquid in the pipe affect the electrical output from the ionisation chamber and the result is shown on the indicator/control unit. Radiation risks are said to be nil, the sources being completely sealed.

Automatic control unit (N604) is said to enable full control of product thickness or substance in processes in which a nucleonic gauge is used. The parameters of the unit may be varied over a wide range to suit different methods of manufacture. Greater uniformity of product and a large reduction in the quantity of off-gauge material will, it is said, often repay the cost of an installation in a few weeks.

Testing Sieve Shaker

In addition to their range of testing sieves, **Endecotts [Filters] Ltd.**, Merton Park, London SW19, are to show a new streamlined testing sieve shaker. Totally enclosed and fitted with anti-vibration mountings and a built-in time switch, the machine will demonstrate the rapid analysis of particles on transparent rimmed test sieves, showing the time-saving that can be achieved in separating operations. The operator has only to set the machine, press the time switch and record the result.

Testing sieve shaker by Endecotts

Automatic Polarimeter

The newly-developed ETL-NPL automatic polarimeter (143A), to be shown by **Ericsson Telephones Ltd.**, New Basford, Nottingham, based on an original design by the National Physical Laboratory, is an electronically controlled instrument the output from which can be fed into a recording device. It has particularly wide applications in industries where a large number of routine measurements are made daily. Because it is more sensitive than visual polarimeters, much shorter sample cell lengths can be used without sacrificing relative precision.

The basic range of the instrument is ±0.5° of angular rotation with an ultimate precision of the order of ±0.0002°. By suitably off-setting the zero, the instrument can examine angular rotations within its range of ±0.5° anywhere in the range 0–360°.

The polarimeter makes use of two solenoids, a modulator and a compensator Faraday cell. The modulator is arranged to oscillate the plane of polarisation of a beam through a small angle at a frequency f. In the absence of a sample, and with the polarisers crossed, the intensity of the beam, which is sensed by a photomultiplier, will not contain components at a frequency f, but of 2f. If, however, a sample is present, the intensity of the beam will vary containing frequency components at both f and 2f.

The compensator Faraday cell is thus energised with a current automatically adjusted to compensate for optical rotations of the sample. This current, suitably displayed, corresponds to the rotation produced by the sample.

Portable SO_2 Meter

The EEL SO_2 meter to be shown by **Evans Electroselenium Ltd.**, Harlow, Essex, is a portable meter to enable rapid measurements of the sulphur dioxide in the atmosphere. This instrument, developed by the Central Electricity Research Laboratories, operates on the following principle:

Air drawn from the atmosphere comes in contact with a starch-iodine reagent which is partially discoloured by the SO_2 present. The absorption of light by the unchanged reagent is compared with that of the partially discolourised reagent by means of barrier-layer photo-cells connected to a galvanometer. This instrument is still in the prototype stage.

Also to be shown are the EEL absorptiometer and the EEL flame photometer.

Process Controller

The new Evershed Mk. IV all-electronic process controller by **Evershed and Vignoles Ltd.**, London W4, provides non-interacting control terms, a wide range of proportional, integral and derivative adjustments and the facilities for the inclusion of measuring and recording instruments for statistical and accountancy purposes.

A recently completed control desk for an important chemical process will show Evershed's conception of centralised control by the use of miniaturised instruments. The desk incorporates Mark IV process controllers, indicators, shadow line monitors and a coloured mimic diagram with miniature alarm lamps. The complete installation gives effective plant control with a minimum of personnel.

A demonstration of flow control will show the Mark IV process controller operating from a magnetic flow meter and positioning a valve in a closed flow circuit. This type of equipment is particularly suitable for flow control where corrosive and other conductivity liquids are concerned, and the conventional orifice plate methods cannot be used.

New NMR Spectrometer

The Fairey Aviation Co. Ltd., Hayes, Middx., feature a prototype, their new nuclear magnetic resonance spectrometer for research, chemical analysis and process control applications, a high resolution NMR spectrometer of moderate cost. It has been designed for chemical analysis and the research workers who require a resolution sufficiently high to show chemical shift, at a cost comparable with that of other types of moderately priced laboratory spectrometers.

The protons in different positions in a molecule are subject to varying degrees of magnetic shielding, and hence a high resolution NMR spectrometer records a corresponding series of resonances whose

relative dispositions are frequently termed chemical shifts, and whose relative magnitudes are proportional to the numbers of protons in each position. Elucidation of the finer details of complex structures is usually possible by correlation with NMR spectra of similar groupings in simpler molecules of known structure.

Used in this way the NMR spectrometer is a valuable research tool which, while giving a new type of information hitherto unobtainable will probably find its greatest use as an adjunct to existing spectroscopic methods.

The resolution which is of the order of 2-3 milligauss (in a field of 5,000 gauss), has been achieved with a comparatively small permanent magnet. No special equipment is required to contain the sample under investigation other than a standard delivery tube and this is simply positioned in the probe. A large tuning dial is engraved in terms of the appropriate elements and tuning indicated on a meter. The spectrometer output is graphically presented on a pen recorder.

Electronic Tank Gauge

The latest development in US liquid gauges, the Gilbarco electronic tank gauge is to be manufactured in this country under licence. The unit employs a level-seeking electronic device giving high accuracy to within $\frac{1}{16}$ in. for very deep tanks. A large number of tanks may be read in sequence on one receiving unit and facilities for tank contents average temperature measurement are provided. The equipment, which also feeds information to a data recording system, will be shown by **Firth Cleveland Instruments Ltd.**, Treforest, Glam.

Control of Liquids

A display of **Fischer and Porter Ltd.**, Salterbeck, Nr. Workington, will feature model 2700, a new type of indicating Flowrator of unique design, where no bolts or nuts are used on the assembly. The metering tube is spring loaded into position, and no traditional types of packing rings are used. The tube is easily accessible for cleaning. These instruments can be supplied with the metering tube scaled to suit the user's exact requirements, or on a shorter delivery, with the tube scaled to read from 10 to 100 per cent.

Model 1615 is the latest type of Flowrator Pneumatic Transmitter. It has a simple linkage system to facilitate easy adjustment of settings. Also on show will be high accuracy turbine flowmeters for the metering of liquids, including gases, a pneumatic controller and a specific gravity tester.

A new catalogue, UFTI, to be issued at the exhibition, covers the company's range of variable area Flowrators for the indication, transmission and recording of rates of flow of liquids and gases.

Mercury-less Diaphragm Flow Meter

In the display by **Foxboro-Yoxall Ltd.**, Redhill, Surrey, there is a new mercury-less bellows type diaphragm flow meter (Type 37) which measures a range of different pressures from 20-200 inches of water at static pressures up to 2,000 p.s.i. Other features are—a frictionless flexure pivoted drive unit; positive protection against overrange; a simple method of range change; full, externally adustable, range damping and built-in temperature compensation for all differential ranges.

The Foxboro M/40 series of rectangular cased recorder controllers has the newly designed pneumatic indicating controller, the M/41A, capable of on/off action and a proportioning mechanism with an adjustable band from a quarter of 1 per cent to 25 per cent of scale range. It may be used with any standard Foxboro measuring element for such variables as pressure, temperature, open tank liquid level, humidity, etc.

Also on show for the first time will be a new direct mounted liquid level transmitter, the 13FA, operated on the force balance principle, which measures liquid level in open or closed vessels and transmits an output air signal direct to standard 3-15 p.s.i. receiver/recorders and controllers.

Level-Measuring Oxygen Unit

Among new items to be exhibited by **General Electric Co. Ltd.**, Magnet House, Kingsway, is the transistorised level-measuring unit for liquid oxygen or any liquid.

Liquid oxygen convertors manufactured by British Oxygen Co. contain a capacitative sensing element which completes a capacitance bridge circuit in the gauging unit. The bridge is fed by a self-contained oscillator working on 28V d.c. supplies, the error signal from the bridge being amplified for electrical instrument readings. The indicator is of a standard small SAE type. As well as showing the quantity of liquid oxygen it gives warning of any failure to the supply or the gauging system. Cast in synthetic resin to ensure rigidity and freedom from moisture, the unit employs printed circuits and GEC transistors. Power supply—28V nominal (25-29V permissible); power consumption—less than 1.5 watts; size of gauging unit—$3\frac{1}{8}$ in. x $1\frac{1}{4}$ in. x 2 in.; weight of gauging unit—less than 1 lb.; size of indicator—$2\frac{1}{4}$ in. dia. SAE standard case, $2\frac{1}{2}$ in. long.

Tight Shutting Butterfly Valve

The exhibits by **James Gordon and Co. Ltd.**, Dalston Gardens, Stanmore, Middx., will include a new design of butterfly valve suitable for all sizes above 6 in. (patents applied for) which is absolutely tight shutting.

A selection of Gordon controllers for pressure, temperature, flow etc., as used for process control, combustion control etc.; Mono gas analysis recorders including the Mono oxygen recorder, and recorders for CO2, CO, H2 etc.; and Igema remote water level indicators with new developments in telemetering and alarm equipment.

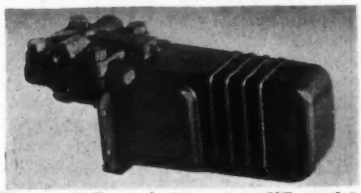
Quickly Assembled Control Units

An improved method of assembly control units and desks is being demonstrated for the first time by **Hallam, Sleigh and Cheston Ltd.**, Oldfield Road, Maidenhead, Berks. Three bolts are used in each complete corner assembly. All that is now needed for assembly of main frame Widney-Dorlec 'Quick-Fit' components is one bolt concealed in each section passing through the main hole in the corresponding corner flange.

Differential Transmitters for Low Pressure Liquids

The display by **Honeywell-Brown Ltd.**, 1 Wadsworth Road, Perivale, Middlesex, will include a system of pneumatic instruments showing how flow, liquid level and pressure are controlled in a fractionating column. Tet-O-Set miniature instruments incorporate for the first time two pen recorders, and the company's range of differential converter transmitters can now measure the lowest pressure differentials with high accuracy. The new low-range model on show has a range adjustable between 0-5 in. and 0-25 in. w.g. and is of interest where measurement is required of low-pressure liquid and gas flows, or flow, level and specific gravity under low static pressure is required.

Pressuretrols and Vaporstats direct-acting pressure controls will be a new feature in the display. They provide on-off and proportional control of pressure, and are stated to be suitable for the control of conditions in vats, kettles, ducts, pipes, boilers and other heat exchangers. Spans range from 0 to 30 in. w.g. minimum up to 0-300 lb./sq. in. maximum.



Honeywell-Brown's low-range differential converter

A range of diaphragm control valves will be on view for the first time. The valves include single-seated, double-seated, low-flow and three-way types, available in a variety of body sizes.

Valves for Process Control

A range of valves designed for process control and automation in bronze, cast iron, forged steel, cast steel and all stainless steel will be shown by **Hunt and Mitton Ltd.**, Oozells Street North, Birmingham 1. Teflon or Teflon asbestos gland packing is used with some patterns as standard, but is available to others if required.

In pneumatic valves Hunt and Mitton have produced non-standard valves to meet exceptional requirements. One example to be exhibited is a very small ($\frac{1}{4}$ in. bore) cylinder-operated shut-off valve designed for alternate pressure and vacuum service.

Forced Ventilation Rack

The latest forced ventilation rack of **Alfred Imhof Ltd.**, 112-116 New Oxford Street, London WC1, is available in eight standard sizes. It is fitted with an exceptionally powerful fan and, in addition, has semi-sealed doors with three-point locking on the specially strengthened size doors. The new rack is expected to be very useful wherever a high degree of cooling is required.

For prototype work or small quantity production, there is the Imlok system of construction.

Carbon-dioxide Analyser

Besides the new gas analyser shown at the Physical Society Exhibition recently, **Infra-Red Development Co. Ltd.**, 40 Tewin Road, Welwyn Garden City, Herts, will be exhibiting a type SC/LA infra-red gas analyser designed to measure carbon dioxide and a type SC/LA analyser fitted with an internal pump, flowmeter and throttle, and arranged to measure nitrous oxide. This instrument is for use in the detection and measurement of leaks in welded structures of hermetically sealed components. Also on show will be a type SB/K gas concentration recorder which is suitable for continuous plant operation and can be made to measure many gases and vapours in a wide range of concentrations. Although not flame-proof, provision is made for the apparatus to be continuously flushed with inert gas and it can be fitted with alarm contacts, either to make or to break external circuits at a predetermined gas concentration level. The information obtained can be transmitted on a self-contained recorder to a distance, to operate other electric or pneumatic recorder-controllers.

Speedomax Instruments

The **Integra Leeds and Northrup Ltd.** 183 Broad Street, Birmingham 15, exhibit will comprise a wide range of Speedomax and Micromax intruments, all of which will be *working models*, the range embracing some 350 basic circuits. Variables for which instrumentation is exhibited include conductivity, load, voltage, force, humidity, pH, moisture, position, redox-potential, resistance, speed, weight, etc.

Exhibited for the first time is the new long door model of the recently introduced Speedomax H, in which the control unit instead of being separately mounted on the panel is now an integral part of the measuring instrument, the control unit pulling out like a drawer.

Oxide Film Glass Resistors

A selection of the Pyrex brand laboratory and scientific glassware will be exhibited by **James A. Jobling and Co. Ltd.**, Wear Glass Works, Sunderland.

The display will include a range of products in glass, made essentially to meet specific demands of the electronics industry. Examples will be shown of the newly developed oxide film glass resistors and of Multiform glass products.

Tank Contents Indicators and Pressure Gauges

Marked expansion will be noted in the range of tank indicators, controllers and recorders produced by **KDG Instruments Ltd.**, Manor Royal, Crawley, Sussex.

The continuous reading pneumatic tank contents indicator comprises a complete self-contained piped assembly, ready for installation and consisting of a calibrated tank contents indicator, a pressure regulator/bubbler unit, a master air pressure supply indicator, and vent valve for zero checking. The unit can be positioned above or below vessel or tank to be measured and is connected to a stand-pipe assembly via a length of metal tubing. The instrument is also available as an on/off level controller. The mechanical pneumatic tank contents indicator is similar in principle to the above, save that a hand pump replaces the compressor for applications where the latter is not available.

The specific gravity indicator works on the same basic principle as the pneumatic tank contents gauge but the stand-pipe assembly is replaced with a special twin stand-pipe assembly and the normal indicator is replaced by a differential pressure gauge calibrated in terms of specific gravity.

The differential gauge for high static pressures measures differential liquid or gas pressures and is suitable for use on static pressures up to 150 p.s.i. It is suitable for flush panel mounting. All parts in contact with the liquid or gas are non-ferrous alloys. Ranges available are 0-25 in. H_2O, 0-50 in. H_2O, 0-110 ft. H_2O, 0-20 ft. H_2O, 0-10 p.s.i., 0-20 p.s.i., and 0-30 p.s.i. Two models are available, one having the addition of an overload protection device against full static pressure. In the working static pressure an accuracy of $\pm$ 2 per cent full scale deflection at any point on the scale is offered, with a $\pm$ 4 per cent accuracy over the complete static range.

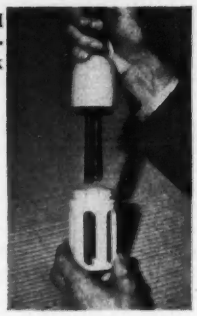
3-Position Temperature Controller

New equipment on show by **Kelvin and Hughes (Industrial) Ltd.**, Barkingside, Essex, is a 3-position indicating temperature controller of the photo-transistor type, which will be of interest to such industries as the plastics industry where it is required to maintain controlled conditions within very close limits. The instrument has two separate control actions, each operating a single pole change-over switch. The two set points are independently adjustable relative to one another over a band width from zero to 10 per cent of the full scale. The band width selected may be positioned anywhere over the 8 in. length of calibrated scale.

Miniature Primary Elements for pH

Demonstrations will be given of the single-point universal pH recorder by **George Kent Ltd.**, Luton, Bedfordshire, using the new miniature glass-electrode primary element. This is a smaller version of the current model. Its principal advantages are that by utilising a reproducible single seal of the metal-to-metal type between the electrode unit and the body, an assembly is produced which is completely impervious to water vapour and can be totally immersed in boiling solutions for very long periods, very little maintenance being required.

The equipment has been designed to cover a wide range of uses in industrial pH measurement. Three varieties of glass electrode which are very robust and long-lasting cover the ranges 0-14pH and temperatures up to 100°C. The new calomel section of the reference electrode gives a superior high-temperature performance,



Kent miniature pH glass electrode primary element (tank type)

and since the electrode eliminates devices such as large reservoirs of potassium chloride solution, it is suitable for operation in high and fluctuating pressures.

Of all-metal construction the unit is totally enclosed in synthetic rubber that is unaffected by acids or alkalis. Two types of assembly are available: the tank type, over-all diameter 2¼ in., can be fixed so that the electrodes just dip into the liquid, or the whole assembly can be completely submerged; the flow type is mounted so that the electrodes are contained in a hopper with integral seals for the inlet and outlet pipes. Liquid to be measured does not come into contact with any other surface than the synthetic rubber with which the hopper is lined.

Ultrasonic Cleaning Cabinet

Latest addition to the Kerry range of ultrasonic cleaning plants developed by **Kerry's (Ultrasonics) Ltd.**, Tonbridge Road, Harold Hill, Romford, Essex, is the model SHD.1 high frequency cleaning equipment, which operates at 1 megacycle with a peak pulsed output of 2 kW. The tank measures 13 in. x 13 in. x 14 in. It has been designed for removing fine particle contamination from intricate metal components, using perchlorethylene as the cleaning solvent. It has been supplied to a leading producer of artificial fibre yarn for cleaning of spinnerettes during manufacture.

This model can also be supplied as a low-frequency equipment for use with perchlorethylene or aqueous-based solution.

Humidity Cabinet

Among exhibits to be featured by **Laboratory Equipment (London) Ltd.**, (laboratory sales division of Weyco (Equipment) Ltd.), Libra Works, 18-20 Dames Road, London E7, will be the Weyco automatic climatic cabinet, which is stated to give precise and accurate control of temperature and humidity. Humidity is created by means of atomised water instead of steam injection. High humidities are thus obtainable at temperatures from ambient upwards. The company is developing a range of portable humidity chambers and units capable of converting rooms into humidity-controlled rooms.

The new Weyco airflow laboratory oven is also based on the positive airflow system of the climatic cabinet. A Weyco heavy-duty stirrer will be on show which, it is stated, will mix most liquids. It has a wide range of speed with useful power at lower speeds.

New Hard Ceramic

Sintox industrial ceramic material will be shown by **Lodge Plugs Ltd.**, Rugby, who are the sole manufacturers. It is an impervious alumina having as salient features hardness equivalent to that of sapphire, high thermal conductivity, good electrical and mechanical properties at high temperatures and resistance to abrasion and chemical attack. These last properties have led to its use in providing thread guides for use in the manufacture of synthetic fibre. Where conditions of chemical attack are particularly severe a special grade can be supplied.

Transportable X-Ray Equipment

Transportable 160 kVp equipment type TF 1584 which will be exhibited by **Marconi Instruments Ltd.**, St. Albans, Herts, is stated to be suitable for laboratory, workshop, or field use. This latest addition to the range of Marconi industrial X-ray equipments provides a half-wave rectified output suitable for X-ray insert tubes rated up to 160 kVp 10 mA. The equipment comprises twin h.t. generator units, a tubehead and a control unit; an optional oil-cooler unit is available for use at the higher tube ratings.

A feature of the tubehead design is that, by a system of oil-sealing, the insert can be rotated through 235° about its long axis in conjunction with the exit port while the shield remains stationary. This gives greater freedom of movement without twisting or distortion of the cables and hoses, which are terminated at one end and side-by-side on the long axis of the tubehead. The twin generators occupy the minimum of floor space and the control unit, which is simple to operate, can be placed at any convenient position. The complete equipment is fully transportable and can be installed quickly and easily.

Auto Preset Equipment

One of the exhibits by **Measurement Ltd.**, Dobcross, Oldham, Lancs, will be the Mark III auto preset equipment. This equipment is used where it is required to dispense preset quantities of liquids and is actuated by the company's rotary piston type of meter. Its function is similar to that performed by the Mark II equipment, but the method of indication and the action of presetting differ. In addition, the Mark II indicator dial graduations are limited to 100, whereas there is no limit to the total on the Mark III apparatus.

With the Mark III apparatus there are three alternative methods by which the preset quantity is selectable: Push button:—10 buttons represent unit digits and 10 buttons represent 10 digits (hundreds and thousands can also be included); rotary switch:—A ten position switch is used for each digit, and these positions are clearly numbered 0 to 9; punch card reader unit:—Where presetting is entirely automatic once the correctly prepared card has been fed into the unit.

Piston Burettes

Exhibits from **Metrohm Ltd.**, Herisau, Switzerland, include piston burettes and the Metrohm Polarecord E 261.

The piston burette E 274 features are easy operation and reading while sitting, no parallax errors, total scale length is approximately 6½ ft. with 1,000 divisions and absolute accuracy is claimed to be better than with conventional, standard precision burettes (better than 1 per cent of burette capacity).

Also available is a Metrohm piston burette with motor drive (E 298). Divisions on the scale drum are 2 mm. apart and one division represents 1/1000 of the burette volume. The reading is made in a very narrow field of view. This burette can be emptied in 30 or 60 seconds. At the slow speed it is possible to add the reagent in individual drops. The burette can be filled automatically within 30 seconds.

The Metrohm Polarecord E 261 is a direct reading instrument for polarography, amperometric titrations and measurements of potentials and potentiometric titrations with low-resistance measuring chains. The potentiometer has a setting force of approximately 500 g. (18 oz. approximately). Recording width is 250 mm. (10 in.). Metal ion concentrations to 10^{-6} molar can be determined and under favourable conditions 10^{-7} molar. Measuring accuracy of the recorder is stated to be better than 1 per cent of final range value. Compensation of the charging current is adjustable continuously within the range of 1.10^{-10} to 5.10^{-8} A/mm.

Infra-Red Analysers

MSA Lira mill balance and deflection type infra-red gas and liquid analysers will be shown by **Mine Safety Appliances Co. Ltd.**, Glasgow E3. These analysers have been developed by the US parent company. Completely automatic and continuous in operation, the Lira analysers can be used to control continuous or batch processes, to determine and control product quality, to measure toxic or explosive gas concentrations, and to solve a wide variety of production and research problems. The instruments are calibrated from 0–2 p.p.m. or less or 0–100 per cent gas. They can be used to detect one component in a complex stream with little or no interference. Continuous and practically instantaneous analysis of the process stream is obtainable (5 seconds to 30 seconds for full-scale response).

Hand and Clothing Monitor

An entirely new hand and clothing monitor (L.310 Series) has been designed by **Mullard Ltd.**, Mullard House, Torrington Place, London WC1, in consultation with the Atomic Energy Research Establishment, Harwell, for the rapid detection of contamination on personnel handling radioactive materials. The monitor is constructed in unit form to give maximum flexibility in both the number and type of monitoring facilities; all facilities can be operated simultaneously so that large numbers of personnel can be handled quickly; and, in addition, the time required for each monitoring facility has been reduced.

The standard, all-purpose equipment comprises six units: 3 alpha units for left and right hands and clothing, and 3 beta-gamma units for the same functions. Two units are mounted side-by-side, with the clothing units at each end of the equipment. Fittings and interconnecting wires are arranged so that alpha units can be quickly substituted for beta-gamma units and vice-versa. Detected contamination is indicated by a meter fitted to each unit which is calibrated in terms of the maximum permissible level. Red indicator lamps are switched on and an alarm bell rings if the contamination is in excess of 1 m.p.l. The alarm bell also sounds if hands are removed from the monitor before the specified 5-second counting period is up.

Process Timers

Process time controllers (models 2055 to 2059) introduced by **Nagard Ltd.**, Belmont, Surrey, are said to have timing intervals and repetition accuracies that are better than 2 per cent. These units ranging from 0–11 seconds in 0.1-second steps to 0–10 minute in 6-second steps may be coupled together to provide automatic cycling for sequential operation, and are started by pressing a button.

The relay contacts can handle up to 5 amps 250 v. a.c. non-inductive and may be arranged to either open or close an external circuit which is to be time controlled. Signal lights indicate when a timing period is started and stopped.

Valuable features of these units are that they can easily be altered in range by plug-in resistor boards, they are fully stabilised against mains variations which do not affect their accuracies, and they are said to be low in cost. Special versions can be designed to suit specific process control applications.

Water Hardness Monitor

In conjunction with the Central Electricity Authority **Nash and Thompson Ltd.**, Oakcroft Road, Chessington, Surrey, have developed a water hardness monitor for use in industrial boiler houses. It will sound an alarm or initiate corrective action when the total hardness content of the feed water being monitored exceeds a preset figure. This can be as low as 2 or 3 p.p.m. of calcium carbonate.

For estimating hardness the well-known method of titration with the disodium salt of ethylene-diamine tetra-acetic acid is used. A solution of this salt, ammonia buffered, an indicator solution of Erichrome black, and the water under test, are all fed at controlled rates into a mixing vessel. The colour of the resulting mixture changes sharply from blue to red as the hardness of the water rises past a value dependent on the concentrations and flow rates of the solution. The mixed solutions are examined in an optical cell through which passes a beam of red light, the amount of light transmitted rising sharply as the mixture changes colour. This light falls on a photocell which operates a relay as the colour changes, and this relay in turn controls the alarm circuit and any external circuits which are necessary to change over or regenerate the water softening plant.

Test solutions are held in bottles housed inside the instrument case (refilled every three days). The bottles are fitted with constant head devices and the rates of flow from them, and the flow of feed water, can be adjusted and checked at a special dripper block. When the relay trips a

sample of the incoming water is trapped in a specimen bottle so that it may be examined chemically at a later date if this is thought desirable. There is also provision for injecting test water of known hardness during the initial setting up and adjustment of the instrument.

Air Equipment

The display by **C. A. Norgren Ltd.**, Shipston-on-Stour, Warwick, will include compressed air equipment, air filters of manual and automatic type, air purifiers and pressure regulators. The company's automatic drain air purifiers have been further improved by the use of a new draining mechanism. These filters, which drain whether or not compressed air is flowing, can now be used over the range from 5 to 250 p.s.i. and the maximum operating temperature has been extended to 200°F. Practical demonstrations of Norgren equipment will be given.

New N and Z Gauges

Details of the new range of Ivix quality gauges will be indicated by **Negretti and Zambra Ltd.**, 122 Regent Street, London W1. These gauges are available in three sizes, 4 in., 6 in., and 9 in. and for projection, wall or flush panel mounting. Accuracy is guaranteed to be of BS specification. Smooth action is obtained by precision cut rack and pinion. A Bourdon stop is used enabling high overload to be withstood. A diaphragm-operated movement is fitted for ranges from 0–30 p.s.i.

New Vapour Fractometer and Spectrometers

Four new instruments will be exhibited by **Perkin-Elmer AG.**, 160 Cheapside, London EC2. Model 137 is an infra-red spectrophotometer which has been specially designed to give a compact size, ease of operation and low cost. The instrument is based on the double beam principle, giving maximum convenience and flexibility. Its performance is stated to be adequate for a large proportion of all infra-red work.

The model 4000 spectrophotometer records spectral data from 200 mμ in the ultra-violet to 2.8 mμ in the near infra-red. The information is presented on three charts covering respectively the ultra-violet, visible and near infra-red. Each region can be covered in as little as 90 seconds.

The Perkin-Elmer vapour fractometer, model 154, is designed to use the gas chromatography principle. It is described as a rugged, versatile instrument employing thermistor detectors which give high sensitivity without the use of an amplifier. There is a wide range of accessories for precision sampling under various conditions.

Model 184 is designed for direct analysis of gaseous streams. Sampling is automatic and the concentrations of up to four components are recorded on a bar graph presentation.

X-Ray Image Intensifier

Demonstrations will be given on the stand of **Philips Electrical Ltd.**, Shaftesbury Avenue, London WC2, of visual examination using the industrial X-ray image intensifier. With closed-circuit equipment simultaneous examination can be carried out by a number of persons. X-ray diffraction equipment, simulating fluorescent analysis, is complete with an electronic circuit panel.

The Philips' gas refrigeration machine which produces liquid air, nitrogen, etc., within 15 minutes of starting up, will be shown in operation.

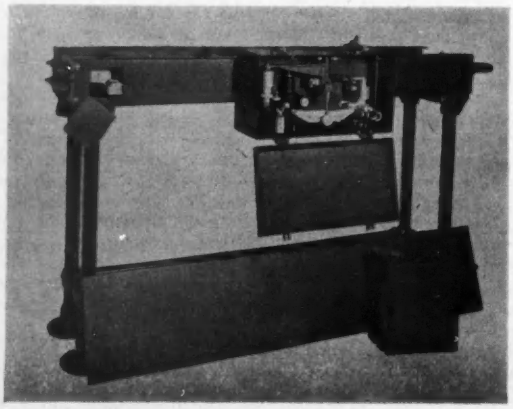
Seamless Flexible Hose

Plessiflex, a metallic, seamless, flexible hose, to be shown by the **Plessey Development Co. Ltd.**, was introduced as a method for overcoming problems associated with the conveyance of liquids or gases at high pressures between junctions, which are initially mal-aligned, move angularly, vibrate, or are exposed to high and low temperatures. It also claims to provide a solution to problems where difficulty in using rigid piping is encountered.

Density Meter

The RM continuous weighing density meter for liquids and slurries will be demonstrated by **Rotameter Manufacturing Co. Ltd.**, 330 Purley Way, Croydon, Surrey. In this instrument, which incorporates a glass pipeline with p.t.f.e. bellows connectors, the fluid flows through a loop of pipe which is continuously weighed on a pneumatic force balance. The output air pressure of 3 to 15 p.s.i.g. is linearly related to density change.

The recently developed transmitting density meter for clean liquids will also be demonstrated. Working on the same principle as the RM density meter, it is claimed to have a minimum sensitivity 0.03 g./ml for full-scale deflection. Working pressures up to 75 p.s.i.g. can be accommodated.



View of the Rotameter transmitting slurry density meter with covers removed

Glass Stirrer Gland

A new glass stirrer gland, which it is claimed will operate under vacuum down to 0.07 mm. Hg, will be shown by **Quickfit and Quartz Ltd.**, Stone, Staffs. Other Q. and Q. exhibits will include open neck reaction vessels, counter current liquid/liquid extraction apparatus, a 14-assembly semi-micro portable laboratory and a glassblower's kit.

Large Scale Level Controls

Level controls recently developed for large scale building materials and chemical processing plants will be shown by **Radiovisor Parent Ltd.**, Stanhope Works, High Path, London SW19. These work on the photo-electric modulating principle. Straight-forward electrode conductivity units will also be shown.

The latest version of the Radiovisor industrial smoke density indicator/alarm type RV2 and the smoke alarm unit type SA56 will also be shown. Both these have recently been approved for a licence for the Kite mark of the British Standards Institution.

Measuring Instruments

Sangamo Weston Ltd. 22–26 New Oxford, Street, London WC1, will be showing a range of electrical measuring instruments including laboratory standards, portable, switchboard and panel instruments, Weston standard cells, photo-electric cells, millivolt amplifiers, photographic exposure meters, instrument switches, moving coil relays, tachometers and thermometer bulbs.

Moisture Meters and Hygrometers

The Shaw hygrometer will be shown for the first time by **Shaw Moisture Meters**, 31 Market Street, Bradford. The detecting element of this instrument consists of a capacitor with a hygroscopic dielectric only a few microns thick, with a 24-carat gold electrode. This is contained in a small, strong, fine wire gauze protector which plugs into a coaxial cable, which can be of any length, connecting it to the recorder.

Uses of the instrument include checks on industrial relative humidity controllers and the quick estimation of moisture in hygroscopic materials. For example, the moisture content of urea moulding powder can be measured to better than one part in 1,000, it is claimed.

Pressure and Temperature Recording Instruments

Instruments to be shown by **Short and Mason Ltd.**, Aneroid Works, 280 Wood Street, London E17, will include mercurial barometers, barographs, thermographs, hygrographs, anemometers, both with the register included in the instrument and with remote registration, and a selection of glass products such as thermometers and hydrometers.

On the Short and Mason stand will be a selection of the Drage range of equipment made by AG Chem. Institut Dr. A. G. Epprecht, Zurich. This will include a range of torsion viscometers varying from educational and experimental laboratory types to more complex instruments for industrial processes.

Metallised PTFE

Examples of metallised p.t.f.e. will be shown on the stand of **Siemens Edison Swan Ltd.**, 155 Charing Cross Road, London WC2, together with samples of rubber bonded p.t.f.e. Samples of p.t.c.f.e. will also be shown.

A convenient means of welding polythene and solid p.v.c. is the electric welding torch which will also be shown.

Automatic X-Ray Spectrometer

The automatic X-ray fluorescent spectrometer, type XZ 736 will be shown by **The Solartron Electronic Group Ltd.**, Thames Ditton, Surrey. Rapid, accurate, non-destructive, automatic chemical analysis is claimed for this instrument. All chemical combinations may be analysed. The process is stated to be very fast and the results are printed out automatically.

Another Solartron exhibit will be the precision analogue computing equipment which can be used to simulate nuclear reactors, pilot and process plant, and heat exchangers.

Non-Destructive Testing Equipment to be Shown

Non-destructive testing will be the theme of the stand of **Solus-Schall Ltd.**, 15/18 Clipstone Street, London W1. X-ray diffractometer No. 50200, with associated electronic ratemeter/amplifier and chart recorder will be shown. Position, intensity and width of diffraction lines from poly-crystals or from single crystals in the plane of motion of the counter tube can be determined. The diffractometer is also suitable for X-ray fluorescence and chemical analysis, quartz and fibre orientation techniques and low angle scattering from clay specimens.

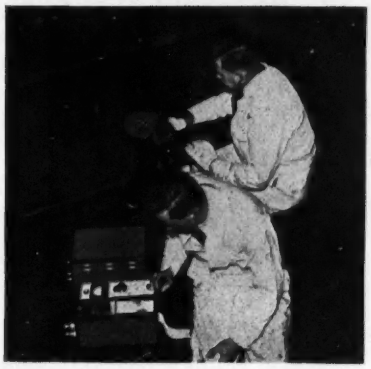
X-ray equipment accessories such as generators, direct angstrom scales, high voltage cable terminators, rectifying valves, filament current stabilisers, transformer, etc., will also be shown.

Portable Flaw Detector

Further improvements in their general purpose portable flaw detector have been made by the **Ultrasonoscope Co. (London) Ltd.**, Sudbourne Road, Brixton Hill, London SW2, who will demonstrate the Mark 1B equipment. These include a new quick recovery amplifier design which increases near surface flaw resolution, while retaining the long-range working ability of earlier models, a special new high definition flat-faced cathode ray tube, and an improved control panel layout.

Corrosion Detector for Tubes

One of the new instruments to be shown by the **Sperry Gyroscope Co. Ltd.**, Great West Road, Brentford, Middx., will be



Sperry Introview flaw and corrosion detector surveying a steam condenser

the Introview flaw and corrosion detector for the internal examination of steam condenser, heat exchanger and other non-ferrous tubes.

A differential pressure transducer for medium pressure operation (up to 1,000 p.s.i.), capable of registering extremely small pressure differentials, will be shown. The production unit will have a flame-proof corrosion resistant case.

Stereoscopic Microscopes

Microscopes of application in science and industry, including a new range of industrial stereoscopic microscopes which have uses in production cycles, control of raw materials and inspection of the finished product, will be shown by **W. Watson and Sons Ltd.**, Barnet, Herts.

The binocular head can be attached on any of a series of mounts which allow movement of the head as required. Inspection of large surface areas, it is claimed, thus becomes a simple matter.

Long focal distance allows ample space in which to carry out delicate operations while viewing. The image is erect and three dimensional. Magnification ranges from $\times 3$ to $\times 140$, and the field of view is nearly 2 in. at the lower power.

Universal Bridge Adaptors

A range of special adaptors has been designed for the universal bridge to be shown by **Wayne Kerr Laboratories Ltd.**, Chessington, Surrey. This, it is claimed, will make the bridge suitable for a wide range of chemical measurements which can readily be applied to process and quality control.

Accurate conductivity measurements using conventional two-terminal cells having platinum electrodes immersed in the solution can be made to an accuracy to 0.25 per cent, or 0.1 per cent if the bridge standards are checked occasionally.

Tests have been carried out on solutions ranging from dilute potassium chloride to concentrated sulphuric acid in the inorganic field and on organic examples such as the kinetics of ester hydrolysis and the conductivity of silver perchlorate in benzene.

Needle electrodes are available which are of use for measurements on pastes and creams and for determining the conductivity of liquids flowing in small tubes.

Regulation of Slow Water Feed

The Pneumerstat, to be shown by **Williams and James (Engineers) Ltd.**, Chequers Bridge, Gloucester, is of use for the accurate regulation of a slow feed of water for laboratory tests and in the continuous sampling of gas for analysis of shed atmosphere and absorption tower outlets.

Originally designed to control the supply of compressed air used for the indication of content, level or pressure, it is claimed to give a constant flow. It can be used for open or closed vessels under pressure or vacuum.

Other W. and J. equipment to be shown will include oil-free compressors, three-stage compressor plants, pressure reducing valves, automatic tank sets and pressure regulators.

First UK Lab. Ware in PTFE

Claiming to be the first UK company in this field, **X-Lon Products**, 48 Gillingham Street, London SW1, will be showing a range of laboratory ware in p.t.f.e., including beakers, evaporating dishes, measuring cylinders, stopcocks and moulded magnets.

Also on display will be products in polythene, using both older high pressure form and Hostalen, a Ziegler type polythene. Perspex and p.v.c. equipment will also be exhibited.

Electric Contact Thermometers

G. H. Zeal Ltd., Lombard Road, Morden Road, London SW19, will show a display of instruments designed for hospital, laboratory, household and industrial uses. Included in the display will be thermometers and hydrometers made in accordance with BS, IP, STPTC, and ASTM requirements.

A range of enclosed scale and engraved-on-stem thermometers will be shown including interchangeable conical ground joints of B.10 and B.14 sizes.

Included for the first time in the display of electric contact thermometers will be a demonstration of a thermometer working in conjunction with the latest plug-in-relay units, controlling predetermined temperatures.

Lab. Fractionating Column

Intended for laboratory use, the fractionating column to be shown by **Glass Developments Ltd.**, Sudbourne Road, Brixton Hill, London SW2, was designed in the research laboratories of The British Petroleum Co. Ltd. for the separation and analysis of complex hydrocarbon mixtures but is claimed to be suitable for general use with all volatile organic materials.

A vacuum jacketed column is employed which may be packed with Dixon gauze rings to give about 100 theoretical plates, or with any other dumped packing. A vapour divider stillhead operated with an automatic timer will be demonstrated but other types of stillheads may be fitted. The reflux condenser and receiver are vacuum jacketed to allow low temperature operation. A manostat-controlled vacuum system which can operate at any set pressure down to 10 mm. Hg. permits substances of high boiling point to be fractionated.

Overseas News

DU PONT ANNOUNCE REDUCED PRICES FOR TITANIUM SPONGE

On 2 April Du Pont announced that they were reducing with immediate effect the price of A-1 titanium sponge by 20 cents per lb. to $2.05 and the A-2 grade by 15 cents to $1.85. This is the second price cut on the sponge in the past year. Other US companies are expected to follow this lead.

Du Pont say that their aim is to increase non-defence uses by making the metal available at lower prices. Until recently the US Government has bought all US titanium sponge at $5 per lb. for defence projects in the aircraft industry. This guaranteed price has stimulated the expansion of facilities, but the reduced military demand in recent months has created a surplus of the metal.

In CHEMICAL AGE last week (p. 639) the closure of several titanium sponge plants was reported.

Chemical Projects in China

Capital investment in chemical projects in China is to total 500 million yuan (6,853 yuan = £1). The new plants will include a synthetic rubber factory and a pharmaceutical plant. Bulk production of penicillin and streptomycin will then be started. Aureomycin will be supplied by the No. 3 pharmaceutical works. New products for the synthetic rubber factory will include tyres for 25-ton trucks and 1,500-gramme pilot balloons.

Trial production will begin of urea, double superphosphate and nitrogen-potassium fertilisers. Nearly half of the capital investment of the chemical industry is to be allocated to fertiliser plants.

New Processes Reported by Universal Oil

At a recent meeting of the Western Petroleum Refiners Association, US Universal Oil Products detailed two new processes. These were the Butamer process which converts *n*-butane to isobutane and is suggested as helping to satisfy demand for alkylation plant feedstock, and the Alkar process which is described as salvaging the light olefin content of refiner's fuel gas as alkyl aromatics. This latter process converts ethylene to ethylbenzene and is expected to be of interest to small refiners who have previously burned ethylene as fuel, as its recovery has been considered impractical.

Linde Expands Nitrogen Facilities

New nitrogen supply facilities have been put into operation in Houston, Texas, and Tulsa, Oklahoma, by Linde Co., division of Union Carbide Corporation. The new units are known as VST installations and will be used to store large quantities of liquid nitrogen. Added to Linde's nitrogen producing centre at Houston, the new units complete a network of distribution facilities that now makes nitrogen economically and readily available to consumers of all sizes in the Gulf Coast area.

The Houston installation has a capacity of more than 1 million cubic feet of nitrogen while the capacity of the new Tulsa installation is slightly less than 1 million cubic feet. Both units will be filled by railroad tank cars from Linde's nitrogen producing plant in Houston.

Since one quart of liquid nitrogen is the equivalent of nearly 800 quarts of gaseous nitrogen, Linde will be able to pass on savings in handling and transportation costs to consumers by storing and transporting nitrogen as a liquid. Tank trucks will be used to deliver liquid nitrogen to local consumers. At the users' plant it will be pumped into stationary storage units. Deliveries made by 1 million cubic foot capacity railroad tank cars will satisfy the demands of extra-large users.

Liquid nitrogen stored in these new units has a boiling point of —320°F, so that Linde engineers were faced with the problem of maintaining an internal temperature of less than —320°F at all times. This problem was solved by designing and constructing the new units like giant vacuum or 'thermos' bottles.

Drop in Italian Consumption of Nitrogenous Fertilisers

Consumption of nitrogenous fertilisers generally in Italy declined in the last half of 1957, compared with the same period of 1956, by 9.1 per cent. Total consumed —July-December 1957 was 629,000 tons. The following are the individual figures: ammonium sulphate (20-21), 257,200 tons, down 14.8 per cent; ammonium nitrate (20-21), 111,080 tons, up 0.7 per cent; ammonium nitrate (26.5), 111,370 tons, up 706.4 per cent; calcium nitrate (13-14), 5,300 tons, down 7.3 per cent; calcium nitrate (14.5), 154,590 tons, down 14.2 per cent; calcium cyanamide (15-16), 89,390 tons, down 28 per cent; calcium urea (26.5), 300 tons in 1956, none in 1957.

Argentina Imports More Chemicals

According to official statistics, Argentina imported last year chemical products valued at US $95.3 million (provisional figure) against 78.1 million in 1956 and 90.8 million in 1955. Imports of chemicals accounted last year for 7.3 per cent of total imports against 6.9 and 7.7 per cent in the two previous years.

Gels Containing 95% Water

Stable gels in which the water content runs as high as 95 per cent are now possible with American Cyanamid Co.'s N.N'-methylene bisacrylamide. It is used in conjunction with acrylic monomers which give normally water-soluble polymers. N.N'-methylene bisacrylamide with the acrylic monomers form stiff gels impermeable to water due to its cross-linking action.

According to Cyanamid, the setting time of each gel can be controlled to range from several seonds to hours. Data sheets are available from the company's Market Development Department, 30 Rockefeller Plaza, New York 20, New York, US.

Austrian Nitrogen Output Up

The Austrian Nitrogen Works, Linz, Upper Austria, recorded last year an annual turnover of 1,100 million Austrian schillings (£15 million approximately), or about 200 million more than in 1956. In terms of volume, production amounted to 906,300 tons, or about 20 per cent more than in 1956. Export accounted for some 60 per cent of the total output, similarly as in the previous year.

New Diversey Plant Opened in Canada

A new plant opened by the Diversey Corporation at Clarkson, Ont., for the production of chemical compounds for food and metal industries will, it is said, save Canada more than the $1 million now spent on imports from the US. The new plant, largest outside the US of the Diversey chain serving 30 countries, is on a 22-acre site, and contains 44,000 square feet of laboratory space and over 14,000 square feet of general office space.

Royal Dutch Shell's Oil Blending Plant at Durban

Mr. F. A. C. Guepin, managing director of the Royal/Dutch/Shell group of companies, opened the new Shell oil blending plant at Durban last month. This new plant is described as one of the most modern in the world, and will import 60 different kinds of additives to be used in the oil and grease blending processes. The plant has a full-scale laboratory staffed by petroleum chemists and testers, and batch samples are already being conveyed for checking of quality and specification direct from operating points in the plant to the laboratory by the Lawson vacuum tube system.

Sicilian Sulphur Industry

By 28 February the stocks on hand of the Italian Sulphur Board (*Ente Zolfi Italiani*) totalled 208,516 tons which is 2.1 per cent more than the total recorded on 31 January 1958. During 1955, 1956 and 1957, Italian consumption of sulphur remained at a practically stationary level of about 100,000 tons a year. Exports of sulphur, instead, increased from 10,000 tons in 1955 to 100,000 tons in 1956 and 173,000 tons in 1957.

Colombia Discovers Iron Ore

New deposits of iron ore have been discovered in the Colombian municipality of Paz del Rio where three others, Coloradales, La Mesa and El Uvo are already being exploited. It is hoped that once the new deposits are being exploited, Paz del Rio will become one of the leading metallurgical centres in South America.

PEOPLE in the news

● MR. H. C. ASKEW, of Reckitt and Sons Ltd., has been elected chairman of the British Disinfectant Manufacturers Association. Vice-chairman is MR. S. L. WAIDE, Newton Chambers and Co. Ltd., and the hon. treasurer, MR. V. G. GIBBS, of William Pearson Ltd. Members of the executive committee are MR. R. G. BERCHEM, MR. A. E. BERRY, MR. W. DEANS, SIR KNOWLES EDGE, DR. N. H. POYNTON, MR. F. W. PRITCHARD, MR. J. K. WILSON and MR. W. MITCHELL. Secretary is MR. W. A. WILLIAMS. These officers and members of the executive committee were elected at the AGM of the association on 25 March.

● At a meeting of the Council of the British Plastics Federation, MR. N. P. PUNFIELD was elected chairman of the Federation and MR. DAVID RADFORD, vice-chairman.

● MR. G. F. FILBEY has been made senior lecturer in physics at Battersea Polytechnic, London, and DR. W. FRANCIS has been appointed lecturer in chemical technology and chemical engineering. These appointments follow the development of advanced technological courses.

● MR. R. P. WRIGHT, aged 34, joined Newton Chambers and Co. Ltd., of Thorncliffe, Sheffield, on Easter Tuesday, 8 April, as Izal factory manager. He will fill the vacancy caused by the death of MR. J. CONNELL. Latterly, Mr. Wright has been production superintendent in the textile processing departments of British Enka, Aintree. He joined that company in 1954 as a maintenance control engineer. After a four-year engineering course at Liverpool University, Mr. Wright joined the Dunlopillo division of the Dunlop organisation in June, 1950. He worked as a design and development engineer in the research and development section before joining British Enka.

R. P. Wright

● MR. P. H. PRIOR has been appointed head of the newly-formed paper and board research and development division of the Reed Paper Group at Aylesford, New Hythe, Kent. He succeeds MR. L. G. COTTRALL, who was head of the technical division and who now moves to Warden Court, Maidstone, until 30 September as technical consultant to the paper and board division.

Mr. Prior joined Albert E. Reed Ltd. as mill chemist a few months after graduating in January 1925, transferring as research chemist in 1930, and eventually becoming chief research chemist. In 1954 he was promoted deputy chief of the technical division. He has been closely concerned with research into Kraft paper at Aylesford. Mr. L. G. Cottrall, who gained his B.Sc. at King's College, London University, began his career in 1913 with the brewers' consultant and public analyst, the late A. Chaston Chapman. After service in the Great War he joined the Horton Kirby Paper Mill, owned by Albert E. Reed Ltd., as a mill chemist, and in 1923 he transferred to Aylesford as chief chemist of the Reed Paper Group. In 1946 he was made chief of the technical division.

● MR. JOHN F. ELLIS, works engineer at ICI's Middleton (Morecambe) factory for almost 10 years, is leaving shortly to become senior design engineer at the company's Billingham plant.

● MR. T. HARCOURT POWELL, a director of Revertex, is to become chairman of the company in due course. MR. A. F. BAILLIE, managing director, who has been acting chairman since the death of MR. D. H. SCOTT, has said that he has no wish to retain the chairmanship. MR. H. F. NETHERCLIFT is to become a director in the place of the late MR. A. PALACHE.

● MR. BRIAN H. TURPIN, managing director of QVF Ltd., has been appointed managing director of Quickfit and Quartz Ltd. He succeeds SIR GRAHAM CUNNINGHAM who continues as chairman. MR. J. D. NUTTALL, director and secretary of the parent company, the Triplex Safety Glass Co., has resigned from the board of Quickfit and Quartz.

● MR. G. MCONIE has been appointed a director of Pilkington Brothers, glass manufacturers.

● MR. DESMOND BOWDITCH has been appointed to the board of Causeway Reinforcement Ltd., of 66 Victoria Street, London SW1, a member of the Amber group. Mr. Bowditch joined the company as general manager in 1957, from the Henry C. Stephens Ltd. group where he was also general manager. Causeway Reinforcement manufacture Hexmetal, a fabrication of steel-walled honeycomb cells for use as a reinforcement for industrial linings, heavy duty floors, and other surface armour applications.

● MR. F. FOWLER, technical manager, MR. J. P. SUTTON, secretary, and MR. C. R. B. WILLIAMSON, marketing controller, of Benger Laboratories and of Benger's, have been appointed directors of both companies.

● MR. P. A. ASHBY has been appointed engineer in charge of design and sales of chemical plant by Freeman Taylor Machines Ltd., Syston, Nr. Leicester, textile and general engineers, and manufacturers of stainless-steel plant.

P. A. Ashby

The company has recently secured the sole manufacturing licence and agency for the UK, Eire and Commonwealth for Olsa of Milan, designers and manufacturers of chemical and pharmaceutical plant, stainless-steel valves, and ancillary plant.

Before joining Freeman Taylor Machines, Mr. Ashby had been head of the chemical plant design department at May and Baker, Dagenham, and chief engineer and manager at Synthetic Chemicals Ltd., Knottingley, Yorks, where he was responsible for the design and construction of plant for the manufacture of phenol and

Executive team of Cyanamid of GB with their new managing director, O. N. Williams (seated). L. to r. Dr. J. R. Wilson, medical director, Dr. E. W. Cook, technical representative for research, Cyanamid International, K. A. Fern, manager, general chemical division, E. G. Walter, general manager, Lederle laboratories division, O. N. Williams, H. C. Plevin, financial director, C. G. Killpack, manager, farm and home division, Dr. J. F. Taylor, scientific adviser, farm and home division, Dr. A. T. Mennie, scientific co-ordinator (British Commonwealth)

Three young Australian technical graduates, who have been awarded scholarships by ICI Australia and New Zealand Ltd. (see 'Chemical Age', 29 March, p. 599), are shown in London. They will spend two years in this country as salaried employees of ICI Ltd.

sulphuric acid. For a number of years he was with the design department of British Oxygen Engineering Ltd., London.

● Dr. A. E. Cashmore has been appointed executive officer of the Manchester Joint Research Council. Dr. Cashmore is an industrial chemist who was, until his retirement, with Imperial Chemical Industries Ltd., alkali division, Northwich, Cheshire.

● Mr. L. Pate, formerly chief engineer with Theodore St. Just and Co. Ltd., has been appointed northern area technical sales representative for QVF Ltd., of Fenton, Stoke-on-Trent. Mr. Pate, who lives at Hillside Avenue, Whitefield, near Manchester, will be responsible for QVF technical sales throughout the north of England.

● Among the full-time senior lecturers appointed at the Bradford Institute of Technology are: department of chemistry and dyeing, Dr. W. R. Moore, Dr. D. G. Lewis, Mr. G. E. Styan and Mr. C. W. Page; biology, Mr. R. Bannister; pharmacy, Mr. R. C. Kaye, Mr. C. G Butler and Mr. K. R. Fell. Mr. P. W. Ramwell, of Leeds, has also been appointed senior lecturer in Pharmacology. Dr. E. London, of Sandbach, is to be senior lecturer in organic chemistry, and Mr. H. Taylor, of Portsmouth, senior lecturer in pharmaceutical chemistry. Bradford education committee has opened negotiations for the purchase of land and buildings for extensions to the Institute of Technology.

● Mr. W. P. Scott, condensing department manager of Worthington-Simpson Ltd., has retired after 22 years in that position. The condensing department will now be administered from Newark, Notts, by Mr. T. Trowsdale, condensing sales manager, and Mr. T. Bennett, condensing contracts manager.

● Mr. S. P. Chambers, a deputy chairman of Imperial Chemical Industries Ltd., has been appointed president of the Combustion Engineering Association for 1958–59.

● Mr. George Boex, a former managing director of British Aluminium and associated companies, retires from the board by rotation on 6 May. Owing to advancing years he does not seek re-election, but will continue in a consultative capacity.

TRADE NOTES

Dismissal For 120

Declining demand for heavy chemicals in the textile trade is blamed for the dismissal of about 120 workers at the Glasgow plant of British Chrome and Chemicals Ltd. Some 650 workers are employed at the Shawfield, Glasgow works, and the company is erecting a new and modern unit adjacent to their present premises.

Manesty Drycota Speeds

The Manesty Drycota can now be supplied by Manesty Machines Ltd., Speke, Liverpool 19, in higher speeds as follows: Model 500, 176-496 tablets per hour; 600, 224-624; 700, 265-713; and 900, 322-987.

Instrument Agreement

Short and Mason Ltd., 280 Wood Street, London E17, have signed an agreement with Aktiengesellschaft Chemisches Institut Dr. A. G. Epprecht, Zurich, under which they will act as sole agents in Great Britain for the range of Drage instruments. An instrument application department has been set up to deal with enquiries and advise on the use and installation of the instruments which include torsional viscometers and rheometers, also plant assemblies for automatic control of viscosity. In addition, the new Drage multitest tensile, compression and bending test machine will be available through Short and Mason.

Permali Celebrate 21st Birthday With New Factory

On 3 April a double celebration took place to mark the opening of the new Permali Group factory at Gloucester and the firm's 21st birthday. Housing the combined production of Permali Ltd., Hordern-Richmond Ltd. and Jabroc Ltd., the new factory is claimed to be the largest plant manufacturing densified wood laminates in Europe.

Corrosion Resisting Cements

Prodorite Ltd., Junction Works, Potters Lane, Wednesbury, Staffs, are shortly to market a new range of corrosion resisting cements. These will include grades patented by Farbwerke Hoechst AG for which Prodorite have obtained manufacturing rights in the UK.

The new range will be divided into two sections, one including silica type cements, and the other resin cements.

DIARY DATES

TUESDAY 15 APRIL

Inst. of Metal Finishing—Torquay: Palace Hotel. 1958 Annual Conference. Until Saturday 19 April.

SCI Plastics & Polymer Group—London: William Beveridge Hall, Senate House WC1. Silver Jubilee Symposium: The Physical Properties of Polymers. Until 16 April.

WEDNESDAY 16 APRIL

SAC Biological Methods Group—London: 'The Feathers', Tudor Street EC4. 6.30 p.m. Discussion, 'The mathematics of sterility testing' introduced by D. Maxwell Bryce.

SAC Midlands Section—Birmingham: The University, Edmund Street 3. 6.30 p.m. 'The analysis of silicones and related organosilicon compounds' by J. C. B. Smith.

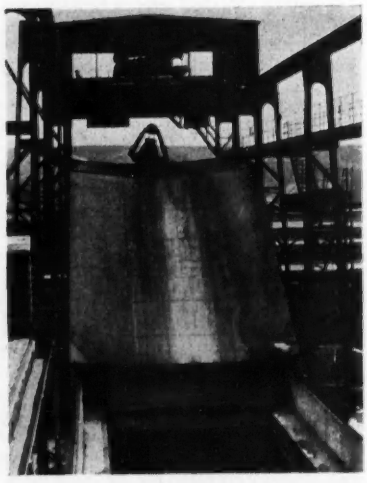
SCI Corrosion Group—London: 14 Belgrave Square SW1. 6.30 p.m. Annual general meeting followed by spring lecture, 'Corrosion research and its industrial background' by W. H. J. Vernon.

THURSDAY 17 APRIL

Royal Society—London: Burlington House, Piccadilly W1. 4.30 p.m. 'The penetration of a fluid into a porous medium or a Hele-Shaw cell containing a more viscous liquid' by P. G. Saffman and Sir Geoffrey Taylor, and 'The catalytic hydrogen reduction and deuterium exchange of cyclopentanone on evaporated metallic films and some observations on cyclohexanone' by C. Kemball and C. T. H. Stoddart.

Monsanto Polythene Progress

In reporting Sir Miles Thomas's annual statement on Monsanto Chemicals Ltd. for 1957 in Chemical Age, 29 March, p. 585, it was stated that Monsanto Chemicals Ltd. produced a variety of polythenes. It should be noted, however, that Sir Miles was referring generally to polythene production in the US and elsewhere. Monsanto is at present constructing a polythene plant at Fawley which is expected to be completed this year.



Ulak No. 4, a primer and epoxide paint made by United Coke and Chemicals Co. Ltd. was coated over 3,000 square feet of the scale chute mill shown in the photograph above. The chute, which feeds a Brinsworth continuous medium width strip mill of Steel, Peech and Tozer, Rotherham, was treated in September 1957 without prior shot-blasting treatment. The company report that the coating is still in excellent condition and no 'lifting' of either the primer or epoxide has occurred

Commercial News

Glaxo–Allen and Hanburys Merger Plan Proposed

UNDER a proposed merger plan, Glaxo Laboratories Ltd. will shortly offer three ordinary 10s units for every £1 ordinary of Allen and Hanburys Ltd.

Each company will retain its own name and continue to trade as at present. Payment of the recently declared Glaxo 6½ per cent interim to existing holders will not be affected, neither will the interim to be declared by Allen and Hanburys (probably this month).

Glaxo ordinary issued capital is £4,778,100 and that of Allen and Hanburys £488,400.

At close on 8 April Glaxo were 37s 3d and Allen and Hanburys 65s, prior to news of the proposed merger.

The boards of the two companies point out that the merger should establish a concern of great strength and comprehensiveness in the pharmaceutical field. Combined net tangible assets would amount to about £17.6 million.

Olin Mathieson

Net sales and operating revenues of Olin Mathieson Chemical Corporation, US, in 1957 totalled $592,877,000 ($598,107,000). Net operating profits in 1957 were $36,377,000 ($39,135,000). Non-consolidated sales of overseas subsidiaries and affiliates totalled $53,300,000 in 1957 ($48,500,000).

The corporation reported that the decline of domestic sales volume was largely due to (1) a sharp decline in dollar sales by the Western Brass division caused by the drop in world prices for copper and zinc; (2) the elimination of approximately $5 million in sales of the Lentheric division, which the corporation sold in late 1956; (3) lower sales volume in the explosives and forest products divisions, and (4) sharply reduced sales from the Morgantown, W. Va. nitrogen and coke plant.

During 1957 sales of chemical products —industrial, agricultural and phosphate chemicals; high energy fuels and propellants; and explosives—accounted for 41.9 per cent of the corporation's total consolidated sales. Metal products accounted for 22.8 per cent; packaging products for 17.6 per cent; and pharmaceuticals, drugs and household products for 17.7 per cent.

Unilever Ltd.

The turnover for 1957 of Unilever Ltd., and Unilever NV showed increases in most of the main commodity groups, but intensified competition has meant that this could only be achieved by an increase of advertising and other expenses, with a consequent reduction in net profits. The combined group's turnover was £1,720 million against £1,671 million, and the profit, before tax, amounted to £85.3 million against £98.8 million.

Expenditure on fixed assets rose to approximately £42 million (£37 million), half of which was provided by depreciation charged for the year, the balance being met from other resources. The sum of £2.5 million went to purchasing new businesses and minority interests. Projects involving expenditure of £38 million were approved in 1957—year-end commitments were approximately £12 million for Unilever Ltd., and £45 million for Unilever NV. Resources are expected to be sufficient to meet 1958 requirements.

As reported in CHEMICAL AGE, 1 March, p. 470, the dividends at 17½ per cent for Limited and 15½ per cent for NV were unchanged.

The directors report that at the beginning of 1957 it was more than usually difficult in some countries to adjust selling prices of margarine and edible fats. In addition the plentiful supply of cheap butter affected markets. Raw materials also rose in price. The decision that profits earned in Indonesia in 1957 should not be included in the consolidated results is given as another contributory factor to the profit setback.

Int. Synthetic Rubber

At the annual meeting of the International Synthetic Rubber Co., last week, Mr. G. E. Beharrell, the chairman, reported that the company's plant at Fawley was nearing completion.

It will be recalled that during the year a further 13s per share has been called on the issued capital of 4 million shares of £1 each, and in November the directors authorised the first call under the debenture agreement with the Finance Corporation for Industry of £1 million. Since the end of 1957 a further call of £750,000 has been made under the agreement.

O. and M. Kleemann

Plastics goods and material manufacturers, O. and M. Kleemann recommend a final dividend of 12½ per cent to make 25 per cent on the original £232,082 ordinary for the year to 28 December 1957. Holders of ordinary shares issued in exchange for Erinoid ordinary will not participate in this dividend.

The dividend is at the same annual rate as the previous payment of 33⅓ per cent for 16 months.

Subject to completion of audit and excluding the results of the new subsidiary, Erinoid, group trading profits amount to £218,308 compared with £239,819 for the previous 16 months. Including a capital profit of £49,500 (nil) there is a balance of £189,751 (£111,333) subject to tax £84,353 (£53,985).

Amber Chemical Industries

Group profit in 1957 for Amber Chemical Industries Ltd. was £17,472 (loss £34,102) subject to tax of £968 (£143 adjustment) of which £1,085 (£356) was attributable to outside shareholders. Current assets are £199,887 (£152,409) and liabilities £109,750 (£88,263). The amount allocated for preference dividend for the year 1953 is £2,875 (nil).

It is reported that principal subsidiaries are operating profitably and results for the first three months of this year show improvement on the corresponding period in 1957.

Market Reports

Easter Holiday Reduces Trade

LONDON The shorter working week has resulted in quieter trading conditions on the industrial chemicals market, although the volume of enquiry on both home and export account has been reasonably good and much of the shipment business is likely to find its way to the order books.

With the exception of the non-ferrous metal compounds the price position remains steady. As from 3 April dry white lead has been reduced by 40s to £116 per ton and red lead by 45s to £104 5s per ton. The new price for litharge is £106 5s per ton.

The routine soda products are moving steadily against contracts, and rather more interest has been shown for chlorate of soda and hyposulphite of soda. There has been no change in the position of the potash chemicals, and there continues to be a steady call for such items as formaldehyde, hydrogen peroxide, borax and boric acid. A good buying activity in fertilisers has been reported, and in the coal-tar products section available supplies are finding a ready outlet with a steady call for creosote oil and cresylic acid.

MANCHESTER Easter holiday stoppages at consuming works in Lancashire and the West Riding have made for much quieter conditions on the Manchester chemical market during the past week. Deliveries of the soda compounds and other heavy chemicals against contracts have been interrupted and not much in the way of fresh business has been reported. The movements of fertilisers and both light and heavy tar products have been similarly affected. There are, however, already signs of a return to more normal trading conditions.

GLASGOW Conditions on the Scottish heavy chemical market have shown little change on the previous week's trading. The prevailing demands are still for nominal quantities against current requirements, with those against contracts fairly well maintained.

A little more activity has been shown in regard to agricultural chemicals, while the overseas market continues to show interest.

Prices generally have been firm with little alteration.

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CHEMICAL ENGINEERING SYMPOSIUM PAPERS

CHEMICAL REACTION ENGINEERING. Edited by *K. Rietema*. Pergamon Press, London. 1958. Pp. viii + 200. 80s.

This volume comprises the collected papers and discussion of the first European symposium on chemical engineering. The subject of the symposium, and hence of the book, was chemical reaction engineering which is defined as being a new branch of the science of chemical engineering aimed at controlling chemical conversions on a technical scale with the ultimate object of developing successful methods for the design from first principles of reactors.

Almost all the authors are at pains to emphasise the essential chemical engineering nature of the subject and its interrelation with hydrodynamics, heat transfer and mass transfer. In the introduction the fundamentals of chemical engineering in terms of the modern concept of these three phenomena, rather than a large number of unit operations, are presented, almost self-consciously as if the authors have just discovered this idea which is now at least five years old. Nevertheless the first paper by Professor Kramers is a masterly exposition of the current philosophy of the bounds of chemical engineering and includes a marvellously clear summary of modern theories of mass transfer.

After an introductory section the main subject-matter begins with three papers on transport phenomena in heterogenous reactions.

The third section considers the effects of non-uniform distributions on reactions and contains an interesting extension of his earlier work on residence time in reactors by Professor Danckwerts, in the course of which he analyses the concept of 'mixing on the molecular scale' gives it a quantitative definition and shows how it can be measured.

Also in this section Dr. Hoffman discusses technical reaction kinetics for those cases where the reactants are only partially miscible or where one of the reactants is continuously removed from the system during conversion.

The fourth part of this book contains papers dealing with reactor efficiency and stability. Professor Denbigh discusses the effect of temperature profile on reactor yield. Dr. Van Meerden presents a consideration of the character of the stationary state of exothermic processes for given sets of boundary conditions.

The final section of the book is concerned with reactor development. Professor Schoenemann considers how far modern technical developments allow the size and shape of a reactor and the composition of the products to be determined particularly in the field of high pressure processes. The problem of prediction of the absorption of nitric oxide for nitric acid production is discussed by Dr. Brotz and Dr. Schum.

It is well produced and in very clear print which makes it much easier to read than most technical literature. The only disadvantage is the price which, at roughly 4½d a page, makes it a luxury for most people.

D. C. FRESHWATER

Guides to Plastics for the Non-Specialist

A GUIDE TO PLASTICS. By *C. A. Redfarn*. Iliffe and Sons Ltd., London. Pp. x + 150 + 17 coloured charts. 18s.

A CONCISE GUIDE TO PLASTICS. By *H. R. Simonds*. Reinhold Publishing Corporation, New York. Chapman and Hall, London. 1957. Pp. xi + 318. 56s.

These two guides on plastics are for the general reader, or the industrial technician, rather than for the chemist—in fact neither of them contains any chemical formulae.

Dr. Redfarn's book is designed to give a bird's-eye view of the industry and half of the book is taken up with descriptions of the nature of plastics, raw materials, and a summary of methods of manufacture. It is difficult, however, to envisage how far a non-chemist will absorb some of the descriptions, e.g. of polyesters or the Grignard method of manufacturing silicones. The charts, however, will assist the non-chemical reader considerably. A welcome feature is the stress laid by the author on synthetic resins, rather than to the overloaded term 'plastics'.

The short chapter on raw materials, only seven pages, savours at the start of the popular press definition of water, coal and air, but is followed by some chemical definitions which are unlikely to be useful unless followed up in more detail.

As would be expected in an American book, H. R. Simonds' volume is written from a slightly different point of view, and stress is laid throughout on commercial materials, chapter two being devoted to a brief description of 32 classes, in which stress is given to properties. The commercial aspect is again stressed in chapter eight which consists of statements by 42 US companies on the materials made by them, including their annual turnover and profit! Like Dr. Redfarn, the volume by Simonds includes a chapter under the title 'Forms of plastics' which covers a wide range of applications including fibres and surface coatings. This is separated from the more dictionary-like chapter on applications which follows later separated by a chapter on production and prices to give full rein

to the American love of statistics.

On the whole the book by Redfarn will be more useful in this country because of the strong bias by Simonds towards specifically US nomenclature and commercial aspects, which will limit its usefulness outside that country. In addition the price of the British volume is more reasonable.

Both books will be useful in the library of the semi-technical executive in the synthetic resin industry, even if their approach does not make them really useful for the qualified chemist. H. WARSON

1958 Pharmacopœia Increases Synthetic Chemicals Coverage

BRITISH PHARMACOPOEIA 1958. Published for the General Medical Council by the Pharmaceutical Press. Pp. xxvi + 1012. 63s.

The publication of a new edition of the 'British Pharmacopœia' is an important event both for pharmacists and analytical chemists. The trend towards the elimination of natural products of plant or animal origin in favour of synthetic organic chemicals has continued in the new edition. While over 50 new organic chemicals with a great variety of types of structure are added, the only products of natural origin are several antibiotics, absorbable dusting powder (made from starch), absorbable gelatine sponge, oxidised cellulose, various immunological products, dextran injection and the enzyme hyaluronidase.

On the other hand, 12 monographs on natural products ranging from volatile oils to vegetable substances like belladonna root and animal products like pepsin are deleted.

The varied structures of the new drugs emphasise the many different types of chemical substances now used in medicine and also show how compounds of appreciably different structure may have similar actions. This is particularly so among the antibiotics and antihistamine drugs.

Of the three new antimalarials, two, amodiaquine and primaquine, are complex quinoline derivatives related to the natural quinine and one of the earliest synthetic antimalarials, pamaquine. The remaining one, pyrimethamine, has a totally different structure.

One inorganic substance is added—aluminium hydroxide gel, used in an antacid. Several inorganic mercury antiseptics disappear to be replaced by the more effective and less toxic organic compound thiomersal.

Hormones and their derivatives are represented by hydrocortisone and the delta dehydro derivatives of cortisone and hydrocortisone, prednisone and prednisolone respectively. Thyroxine sodium, omitted from the 1948 Pharmacopœia returns. This time, however, it is synthetic instead of natural and laevo instead of racemic.

The fact that the organic chemist can improve on the natural product is further illustrated by the inclusion of benzathine penicillin and phenoxymethyl penicillin, both of which are more effective after oral administration than is the natural benzylpenicillin.

Several new barbiturates are added and also a monoureide hypnotic, carbromal. Two new sulphonamides used in the chemotherapy of bacterial diseases make their appearance and two related drugs, the sulphones dapsone and solapsone, which have done much to improve the prognosis in leprosy, gain recognition. Another sulphonamide derivative is acetazolamide, mainly used as a diuretic.

Two drugs symbolic of the new age are sodium radioiodide (^{131}I) and sodium radiophosphate (^{32}P). Both are used in the localisation of tumours and the former is also used in the diagnosis and treatment of thyroid disease and the latter in the determination of the blood volume.

The methods of assay for chemical substances have been brought up to date in the light of developments in analytical chemistry. In particular, methods such as non-aqueous titration and electrometric titration are now used in several assays.

The use of spectrophotometric methods has been extended, especially in the examination of the steroids and their preparations. These methods are particularly useful in injections and tablets where the amount of medicament may be small. T. D. WHITTET

Introductory Treatment of Electronic Theories

ELECTRONIC THEORIES OF ORGANIC CHEMISTRY. By *J. W. Baker*. Oxford University Press, London. 1958. Pp. vii + 224. 30s.

During the past 25 years the application of electronic theories has led to a revolution in the interpretation of organic reactions and has made it possible to systematise much that appears unrelated from purely classical structural theories. This book is designed as an introductory treatment of electronic theories suitable for advanced sixth form and first year university students.

The author first reviews the nature of chemical bonds and chemical reactions and then considers classical structural formulae. The deficiencies of the latter and their correction are outlined, reagent types clearly distinguished and the inductive effect described. A chapter on the physical interpretation of covalency provides a very clear non-mathematical outline of atomic and molecular orbitals, hybridisation and the nature of double and triple bonds.

The remainder of the book is concerned with the application of the concepts and mechanisms previously ascribed to organic reactions. Successive chapters deal with nucleophilic substitution reactions at saturated carbon, olefin-forming elimination reactions, additions to unsaturated compounds, tautomerism, esterification and hydrolysis, aromatic substitution and saturated rearrangement.

In an introductory treatment intended to form a basis for further study it is essential that broad principles be emphasised and clearly explained and that definitions are

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precise. The author has clearly taken great pains to fulfil these requirements. Although the text as a whole is perhaps rather heavy going for the readers for whom the book is primarily intended there is much that they can read with interest and profit. To their teachers and to chemists wishing to revise or obtain an introduction to modern electronic theories of organic chemistry the book should be very valuable. The production is good and the price reasonable.

W. R. MOORE

Whole Range of Stereochemistry Covered

PROGRESS IN STEREOCHEMISTRY. By *W. Klyne* and *P. B. de la Mare*; Vol. 2, Butterworth's Scientific Publications, London. 1958. Pp. vii + 323. 50s. American Edn. Academic Press Inc. N. York. $8.80.

If the present volume were nothing more than a collection of articles by well-known authors it would be of much value. It has, however, like its predecessor, the great additional merit of careful editorship. The different topics are well correlated and logically arranged. Drafts of many chapters were circulated among several contributors so that contributions by individuals have often been improved by the suggestions and criticisms of other experts. The topics treated span the whole range of physical, inorganic, organic and biological chemistry and the literature has been covered as far as possible up to the end of 1956.

The publishers already enjoy a high reputation for their standard of book production. This must, if anything, be enhanced by the present volume in which the diagrams and formulae are notably clear and elegant.

No university library or research laboratory can afford to be without this work. Indeed, most serious students of chemistry will wish to possess a personal copy.

H. MACKLE

Testing, Characterisation and Specification of Tar Products

STANDARD METHODS FOR TESTING TAR AND ITS PRODUCTS. Fourth Edition. Standardisation of Tar Products Tests Committee, Oxford Road, Gomersal, Nr. Leeds. 1957. Pp. xxvi + 585. 42s.

To secure the use throughout an industry of accepted and standardised methods for the testing, characterisation and specification of its products seems such an obvious piece of commonsense that it is easy to overlook or to underrate many practical difficulties that have first to be surmounted. It must be placed to the credit of the Standardisation of Tar Products Tests Committee (STPTC) that it showed by example how agreement and standardisation of testing methods could be effected in one branch of the chemical industry. All who in the course of their daily work handle tar and tar products, either as producers or users or as buyers and sellers, are aware how greatly their interests have been served by the labours of the STPTC from the time of its formation 30 years ago.

The new edition of the STPTC handbook follows the pattern of its predecessors in style and arrangement, though it is somewhat increased in length. In the main it is a compendium of well-tried methods which have been found in the trade to be easy to apply with a minimum of specialised apparatus. Some of the tests are measurements of physical properties, while others are estimations of undesirable contaminants. Few tar products appearing in commerce are substantially individual substances or are mixtures of a limited number of individuals. Hence only a few of the tests in the book are designed to estimate directly chemical individuals in tar products. A noticeable change from the third edition is that the number of tentative methods admitted has been somewhat increased, although oddly enough no explanation can be found of what the designation 'tentative' is meant to imply.

It does seem rather remarkable that the committee has not yet been able to adapt to its purposes the new and powerful methods of infra-red spectroscopy and chromatography. Such methods are in fact already in use in many analytical laboratories in the tar trade and in other branches of chemical industry. A single example of a chromatographic method (for estimating saturated hydrocarbons in creosote oil) is, indeed, included among the tentative methods, but that is all.

E. A. COULSON

A Lucid Exposition

PHYSICAL CHEMISTRY. By *W. J. Moore*. Longmans, Green and Co., London. 3rd Edition. 1957. Pp. xii + 641. 30s.

Text-book reviews usually end with some comment upon the price and the quality of production; they rarely, if ever, begin with such. The reviewer cannot refrain from making an exception of the present volume, which is, in his opinion, the best value for money on the market. It is excellently produced, the illustrations and diagrams are of the highest quality, the tables of data up-to-date and elegantly arranged, there are good name and subject indexes, and no serious misprints.

What of the author's contribution? To those who know the earlier editions the present one will need no commendation. Professor Moore clearly has the elusive qualities needed to write a really good text-book. His exposition is always lucid and unambiguous, and he has gone to no end of trouble to show how every important physicochemical relationship may be derived from fundamental principles. This is of course crucial to the inculcation of the proper scientific attitude in the mind of the student. As Professor Moore puts it 'the student should try not only to remember facts but also to learn methods.'

The plan and scope of the book are best indicated by the chapter headings which are as follows: Description of physicochemical systems, first law of thermodynamics, second law of thermodynamics, thermodynamics and chemical equilibrium, changes of state, solutions and phase equilibria, the kinetic theory, the structure of the atom, nuclear chemistry and physics, particles and waves, the structure of molecules, chemical statistics, crystals, liquids, electrochemistry, surface chemistry, chemical kinetics, photochemistry and radiation chemistry. The book thus clearly embraces all the important aspects of physical chemistry. It will be invaluable to students reading for the pass B.Sc. degree and to those of their teachers who are interested in the best method of presenting the subject.

H. MACKLE

UK Chemical Exports and Imports for Jan.-Feb.

EXPORTS		QUANTITY Jan.-Feb. 1957	QUANTITY Jan.-Feb. 1958	VALUE Jan.-Feb. 1957	VALUE Jan.-Feb. 1958
INORGANIC				£	£
Acids	Cwt.	40,156	6,788	102,807	135,613
Copper sulphate	Tons	4,902	1,547	454,434	427,596
Sodium hydroxide	Cwt.	835,718	730,622	1,038,632	690,500
Sodium carbonate	,,	711,091	46,500	496,776	333,444
Aluminium oxide	Tons	4,749	5,614	157,537	189,774
Aluminium sulphate	,,	4,612	6,119	68,979	87,633
Other aluminium cpds.	,,	587	555	25,268	21,444
Ammonia	Cwt.	11,785	14,868	40,795	57,495
Ammonium cpds. (not fertilisers and bromide)	Tons	3,457	2,120	128,838	93,956
Arsenical compounds	,,	782	271	57,415	18,761
Bismuth compounds	Lb.	64,470	88,151	54,596	70,110
Bleaching powder (chloride of lime)	Cwt.	37,988	53,313	68,894	91,319
Hydrosulphite	,,	22,023	9,455	174,585	65,656
Other bleaching materials	,,	20,117	31,619	92,417	159,184
Calcium compounds	,,	52,343	66,911	110,293	126,757
Carbon blacks	,,	126,265	178,652	450,129	704,762
Cobalt compounds	,,	1,990	2,865	101,982	113,110
Iron oxides (chemically manufactured)	,,	14,829	10,525	45,251	31,830
Lead compounds	,,	6,194	11,504	40,257	57,591
Magnesium compounds (nes)	Tons	2,787	3,265	137,817	155,237
Nickel salts	Cwt.	15,240	11,898	159,316	129,963
Potassium compounds (not fertilisers and bromides)	,,	6,993	8,680	79,090	86,391
Sodium bicarbonate	,,	108,941	132,781	98,645	120,078
Sodium phosphates	,,	29,115	50,389	127,464	189,466
Sodium silicate	,,	59,059	49,388	52,236	45,301
Other sodium cpds.	,,	229,337	237,940	591,027	637,046
Tin oxide	,,	1,732	1,223	64,188	41,940
Zinc oxide	Tons	1,296	1,128	77,624	84,937
Inorganic chemicals (nes)		—	—	835,112	636,811
ORGANIC					
Acids, anhydrides and their salts and esters		—	—	216,733	232,656
Glycerine	Cwt.	25,264	7,914	226,478	73,013
Ethyl alcohol, etc., and mixtures of such alcohols (nes)		—	—	243,582	260,662
Acetone	Cwt.	20,490	23,153	64,664	69,551
Citric acid	,,	11,157	6,394	107,586	67,950
Gases, compressed, liquid or solid (nes)		—	—	298,972	503,088
Phenol	Cwt.	27,185	28,415	179,662	173,267
Salicylates	Lb.	213,813	153,787	60,658	41,807
Sodium compounds	Cwt.	4,739	4,503	66,260	59,040
Sulphonamides, not prepared	Lb.	271,956	346,913	192,935	206,444
Dyestuffs intermediates (nes)	Cwt.	18,919	11,115	271,376	171,017
Organic compounds (nes)		—	—	2,638,741	2,694,350
Total for elements & cpds.		—	—	**10,500,051**	**10,156,550**
Coal tar	Tons	14,094	9,763	138,662	116,073
Cresylic acid	Gall.	509,741	331,190	187,340	126,049
Creosote oil	,,	3,169,163	5,653,384	216,470	407,459
Other mineral tars and crude chemicals		—	—	95,573	39,665
Pigment dyestuffs	Cwt.	4,294	4,821	177,771	192,957
Other synthetic dyestuffs	,,	37,249	28,440	1,636,284	1,398,117
Synthetic organic pigments	,,	3,854	2,932	155,594	126,532
Vegetable and animal dyeing extracts	,,	907	638	28,495	34,757
Tanning extracts (solid or liquid)	,,	21,811	19,548	99,420	83,463
Synthetic tanning materials	,,	14,467	13,121	52,420	49,005
Pigments, paints, varnishes, etc.		—	—	3,870,047	4,208,035
Drugs, medicines, etc.		—	—	6,248,627	6,484,498
Explosives		—	—	1,755,425	1,825,274
Insecticides, fungicides and rodenticides	Cwt.	61,704	46,377	706,284	657,615
Weedkillers	,,	12,729	10,595	207,711	160,447
Carbons, decolorising or activated	,,	14,328	8,981	59,220	42,660
Tetra-ethyl lead anti-knock compound	Gall.	1,007,352	629,159	2,195,805	1,376,122
PLASTICS MATERIALS					
Aminoplastics, solid and liquid resins	Cwt.	—	38,976	—	252,423
Cellulose plastics, moulding and extrusion cpds.	,,	—	11,308	—	168,316
Phenolics and cresylics, solid and liquid resins	,,	—	17,961	—	147,434
Other phenolic and cresylic cpds.	,,	—	16,096	—	311,763
Polystyrene	,,	—	39,368	—	515,910
Polyvinyl chloride, polymers and copolymers	,,	—	24,242	—	221,241
MISCELLANEOUS					
Photographic chemicals (nes)	Cwt.	7,952	6,582	119,657	119,210
Scientific glassware	,,	3,425	3,539	189,643	187,057
Chemical and gas machinery	,,	21,007	31,151	505,585	730,635

IMPORTS		QUANTITY Jan.-Feb. 1957	QUANTITY Jan.-Feb. 1958	VALUE Jan.-Feb. 1957	VALUE Jan.-Feb. 1958
INORGANIC				£	£
Acids	Cwt.	14,210	15,400	42,659	48,481
Aluminium oxide—					
Crude, unground	Tons	1,257	4,584	62,484	256,215
Ground or graded	,,	719	650	85,581	71,129
Silicon carbide	,,	1,077	1,100	109,052	116,886
Arsenic trioxide	,,	783	1,051	25,183	32,498
Borax, refined	Cwt.	106,517	114,200	202,947	243,273
Calcium carbide	,,	129,594	180,190	242,592	341,819
Carbon blacks, channel	,,	40,847	32,717	227,334	184,528
Other carbon blacks	,,	17,475	29,336	64,898	124,115
Cobalt oxides	,,	591	2,300	36,941	143,813
Iodine	Lb.	387,237	59,246	149,155	22,633
Mercury	,,	325,178	104,761	62,416	97,988
Sodium, calcium, potassium, lithium, etc.	Cwt.	4,675	10	38,126	3,453
Potassium carbonate	,,	22,488	26,740	70,583	89,401
Other potassium cpds. (not fertilisers)	,,	16,930	14,303	77,569	66,531
Selenium	Lb.	32,595	13,561	188,553	47,954
Silicon	Tons	1,048	1,420	161,582	243,596
Sodium chlorate	Cwt.	20,250	3,435	67,003	115,231
Other sodium cpds.	,,	41,308	86,494	146,706	219,731
Inorganic chemicals (nes)		—	—	505,194	757,094
ORGANIC					
Acids, anhydrides and their salts and esters		—	—	297,433	534,001
Glycerine, crude or distilled	Cwt.	10,192	34,010	60,961	207,292
Menthol	Lb.	55,504	26,122	119,880	50,829
Naphtha, methyl alcohol and alcohols and alcohol mixtures (nes)		—	—	291,947	348,206
Turpentine	Gall.	43,155	44,756	12,246	12,659
Glycol ethers and esters	Lb.	1,337,961	995,352	125,704	108,361
Sodium compounds	Cwt.	27,613	16,828	292,743	198,736
Styrene	Gall.	157,990	24,574	85,816	11,632
Vinyl acetate	Tons	1,341	1,126	158,336	131,870
Dyestuffs intermediates	Cwt.	6,814	3,016	228,343	172,799
Organic compounds (nes)		—	—	1,762,173	2,522,762
Synthetic organic dyestuffs and compounds	Cwt.	6,994	5,245	541,631	508,544
Titanium dioxide	,,	11,019	93	112,677	1,034
Other pigments	,,	57,715	46,496	157,330	152,822
Vitamins, their salts and esters		—	—	206,441	275,682
Antibiotics, including penicillin, streptomycin and tyrocidine		—	—	238,926	312,553
Alkaloids		—	—	90,417	117,998
FERTILISERS					
Basic slag	Tons	30,780	33,828	252,763	277,838
Potassium chloride	Cwt.	2,010,138	2,180,395	1,732,852	1,846,172
Potassium sulphate	,,	62,007	70,463	63,983	70,519
Other fertilisers		—	—	373,594	551,448
PLASTICS MATERIALS					
Alkyd solid and liquid resins, solutions, emulsions and dispersions	Cwt.	—	13,141	—	186,692
Cellulose plastics—photographic film base	,,	—	5,561	—	330,921
Other cellulose plastics	,,	—	6,901	—	304,215
Polyvinyl chloride—polymers and copolymers	,,	—	20,041	—	314,052
Other polyvinyl chloride cpds.	,,	—	30,052	—	313,319
Other plastics materials	,,	—	63,833	—	1,428,383
MISCELLANEOUS					
Chemical and gas machinery (nes)	Cwt.	3,277	5,571	155,818	307,372
Explosives	,,	94	38	3,917	1,837

EXPORTS OF ALL CHEMICALS TO PRINCIPAL MARKETS

	Jan.-Feb. 1956	Jan.-Feb. 1957	Jan.-Feb. 1958
Nigeria	975,593	827,350	1,030,087
Union of South Africa	2,265,114	1,965,646	2,444,851
India	3,109,550	3,946,690	2,183,176
Singapore	694,797	781,614	729,603
Hong Kong	494,678	767,333	769,275
Australia	2,939,987	3,071,183	4,116,531
New Zealand	1,184,700	1,079,112	1,570,472
Canada	973,730	982,155	1,019,589
Irish Republic	1,243,468	945,211	1,126,106
Sweden	899,102	1,235,070	1,196,879
Norway	593,951	707,472	745,711
Denmark	713,801	829,413	905,480
Western Germany	906,200	1,226,215	1,434,988
Netherlands	1,407,969	1,615,134	1,618,545
Belgium	886,863	1,097,890	936,285
France	981,917	1,788,189	1,453,211
Italy	1,434,375	1,499,307	1,482,838
United States of America	1,453,779	1,307,207	1,450,651
Mexico	226,686	159,794	193,208
Argentine Republic	383,112	595,544	820,310
Total for all countries	**39,778,895**	**43,438,552**	**43,803,722**

EFFECTS OF AMINO RESIN PRECONDENSATES IN TEXTILES

USES of amino resin precondensates were the subject of an address given to the Midlands section of the Society of Dyers and Colourists recently by Mr. A. R. Smith, British Industrial Plastics Ltd. The amino resin precondensates were used for:
(a) normal crease-resistant finishes, (b) 'minimum iron' finishes—a recent development of (a), (c) dimensionally stable fabrics, and (d) durable mechanical finishes.

Discussing the effects of various factors on results obtained, Mr. Smith said that a precondensate capable of penetrating the amorphous regions of the cellulose was necessary, but a higher degree of condensation was permissible for cotton than for rayon.

Washing-off after resin treatment was recommended to remove by-products of the reaction and improved tear strength and reduced tensile strength compared with unwashed fabric. Mercerisation could improve crease-recovery at higher resin concentrations with less strength loss.

Polyvinyl alcohol usually improved tensile strength but reduced tear strength. Rubber-like polymers might improve crease-recovery.

Certain types of precondensates were more effective crease-proofing agents for cotton. Urea-formaldehyde precondensates gave excellent crease-recovery whether methylated, modified in other ways, or unmodified. The degree of durability demanded of the finish might be greater for 'minimum iron' particularly in the case of shirtings and an improvement may be obtained by using an ethylene-urea formaldehyde precondensate. The 'non-chlorine-retentive' properties of the finish would also be improved in this way.

Mr. Smith felt that these processes should be considered together since in both cases the swelling of the cellulose in aqueous alkaline solutions had to be reduced or prevented. This effect usually followed from the normal crease-resisting treatment and resins of the same type were employed for both crease-resisting and mechanical finishing.

The use of hypochlorite bleaches resulted in the retention of chlorine by amino-resins due to reaction with free-NH groups and interest in 'non-chlorine-retentive' finishes had recently increased.

Melamine resins usually retained chlorine with yellowing of the treated fabric. Urea resins also retained chlorine, but the reaction product was colourless and no visible change in the fabric took place. On ironing the chlorine-treated fabric, however, liberation of hydrochloric acid occurred with urea resins and tendering of the fabric ensued. In the case of melamine resins, the yellow product was relatively stable and little acid tendering occurred.

It had been suggested recently that finishes based on dimethylol ethylene-urea, although having no free-NH groups and therefore 'non-chlorine-retentive' when applied, might not retain this property after repeated alkaline washes. This matter was under investigation, but it was likely that if curing had been incomplete and free methylol groups remained in the system, these could be removed under alkaline conditions and the fabric might then become 'chlorine-retentive'. Excellent 'non-chlorine-retentive' finishes were undoubtedly obtained by careful choice of accelerator and curing conditions, while alternative resins whether nitrogenous or not were less effective crease-proofing agents than dimethylol ethylene-urea.

Speaking of treatment of knitted fabrics Mr. Smith observed that dimensional stabilisation of knitted cellulose fabrics was an obvious application for amino resins and excellent results would be achieved experimentally. In practice, however, the handling of the fabric presented some difficulty.

Mathematical Method for Predicting Solubilities of Fats and Oils

A GENERAL mathematical relationship which provides a means of predicting the solubilities of member compounds in the various homologous series obtainable from animal and vegetable fats and oils has been discovered by Evald L. Skau and Richard E. Boucher, US Department of Agriculture's southern utilisation research and development division, New Orleans, Louisiana. With this equation ($\log N = a + bn$), it is only necessary to know the solubilities of a few compounds in a series in order to predict those of the remaining compounds. Discovery of the equation has practical significance since it supplies new information essential for utilisation research on fats and oils and eliminates the necessity for tedious solubility measurements.

Using fundamental thermodynamic principles, a fundamental equation was devised by Skau and Boucher that led to the conclusion that solubility of compounds in a homologous series, at a given temperature and in a particular solvent, can be plotted against the number of carbon atoms in the molecule so as to form a smooth curve.

From the approximate freezing-point-lowering equation and known empirical relationships between the number of carbon atoms, n, and the heats and entropies of fusion of the members of a homologous series, the following linear equation was derived: $\log N = a + bn$.

This equation showed that a straigh line should be obtained when n, is plotted against log N, the logarithm of the molar solubilities of the compounds in an ideal solvent at a specified temperature, a and b being constants.

Since experimental solubilities ordinarily deviate from ideality, straight lines would not actually be expected. However, since the deviation would in all probability vary regularly as the chain length increased in a homologous series, it was reasoned that the log N versus n plots (isotherms) would at least be smooth curves. These theoretical considerations were confirmed by plotting the solubility data already published in the literature.

The resulting charts, each consisting of a series of isotherms, show at a glance the agreement between the available solubility data for the members of each homologous series in each solvent. By graphical interpolation or extrapolation, solubilities of additional members of each series can be estimated. The charts cover the solubility data for homologous fatty acids, methyl esters, primary amines, symmetrical secondary amines, primary alcohols, symmetrical ketones, nitriles, amides, anilides, N, N-diphenylamides, and esters of stearic acid in such solvents as benzene, cyclohexane, carbon tetrachloride, chloroform, ethyl ether, acetic acid, ethyl acetate, butyl acetate, acetone, butanone, methanol, 95 per cent ethanol, isopropanol, n-butanol, nitroethane, acetonitrile, and water.

In all, 138 charts have been constructed showing the solubility relations of 11 homologous series (some with missing members) in 17 different solvents. These charts can be used to evaluate the reliability of experimental solubility data, to locate discrepancies and to predict the solubility of missing members by interpolation or extrapolation.

NEW PATENTS

By permission of the Controller, HM Stationery Office, the following extracts are reproduced from the 'Official Journal (Patents)', which is available from the Patent Office (Sale Branch), 25 Southampton Buildings, Chancery Lane, London WC2, price 3s. 3d. including postage; annual subscription £8 2s.

Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period.

ACCEPTANCES

Open to public inspection 7 May

Dichloroacetanilide esters and the manufacture thereof. Boots Pure Drug Co. Ltd. [Cognate application 7513.] **794 762**

Low temperature separation of gas mixtures. British Oxygen Co., Ltd. **794 763**

Treating textile materials to render them resistant to shrinkage. Battelle Development Corp. **794 764**

Gas filters. Union-Chemie E. P. Jager Import-Export Chemischer Anlagen und Rohstoffe. **794 450**

Steroid compounds and process. Upjohn Co. **794 483** **794 484** **794 485**

Fungicidal compositions and their use. Monsanto Chemicals, Ltd. **794 769**

Production of acyl derivatives of 5.6-dihydrobenzo [c] cinnoline. Geigy AG., J. R. **794 775**

Insulating materials. Monsanto Chemical Co. **794 616**

Pyridine purification process. Distillers Co., Ltd. **794 618**

Composition of lubricating greases. Esso Standard Soc. Anon. Francaise. **794 619**

Aluminium base alloy. Aluminium Co. of America. **794 622**

Process for the catalytic reforming of hydrocarbon mixtures of the gasoline type. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **794 650**

Steroid compositions and the preparation thereof. Upjohn Co. **794 486**

Preparation of 6-substituted aminopurine compound and product. Wisconsin Alumini Research Foundation. **794 540**

Resinous compositions. Westinghouse Electric International Co. **794 541**

Preparation of refractory metals. Du Pont de Nemours & Co., E. I. **794 681**

Organosiloxanes. Midland Silicones, Ltd. **794 629**

Separation of fractions with different properties from fine porous catalysts. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij **794 418**

Removal of heavy liquids from porous catalysts. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **794 419**

Co-vulcanised butyl rubber with highly unsaturated rubbers. Esso Research & Engineering Co. **794 630**

Etching of titanium, zirconium, niobium and niobium tantulum alloy for capacitor electrodes. General Electric Co. **794 465**

Protecting metals against attack by mineral acids. Esso Research & Engineering Co. **794 466**

Production of diglycidyl ethers of diols. Badische Anilin- & Soda-Fabrik AG. **794 632**

Condensation products of styrene oxide and their production. Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler. [Divided out of 794 644.] **794 645**

Steroid compounds and process for their production. Upjohn Co. **794 487**

Phenolformaldehyde resinous condensation products. Monsanto Chemical Co. **794 634**

9 α-Halo steroids and process for manufacturing same. Schering Corp. **794 468**

Therapeutic composition. Upjohn Co. **794 488**

Production of polyolefines. Badische Anilin- & Soda-Fabrik AG. **794 785**

Sulphanilyl urea derivatives and compositions thereof. Boehringer & Soehne Ges., C. F. **794 552**

Hydrogenation of benzene to cyclohexane. Universal Oil Products Co. **794 553**

Resinous insoluble vinyl aromatic copolymers containing phosphonate groups and sulphonate groups. Dow Chemical Co. **794 793**

Purification of k-phenylenediamine. General Aniline & Film Corp. **794 639**

Isomerisation of unsaturated diols. Badische Anilin- & Soda-Fabrik AG. **794 685**

Lubricating compositions. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **794 688**

Disinfecting compositions. Farbenfabriken Bayer AG. **794 402**

Production of dicyclohexylcarbodiimide. Uclaf. **794 689**

Methylation of xylene. Mid-Century Corp. **794 693**

Manufacture of cellular foams derived from polyisocyanates and polyalkene ether glycols. United States Rubber Co. **794 403**

Stabilisation of chlorinated hydrocarbons. Du Pont de Nemours & Co., E. I. **794 700**

Production of monoazo dyestuffs containing chromium. Badische Anilin- & Soda-Fabrik AG. **794 473**

Anti-foam emulsion for aqueous systems. General Electric Co. **794 405**

Purification and recovery of naphthalene. American Cyanamid Co. **794 705**

Production of microorganism-resistant paper. Dow Chemical Co. **794 406**

Chlorination process. Chempatents Inc. **794 408**

Magnesium alloy. Dow Chemical Co. **794 474**

Benzene purification process. Esso Research & Engineering Co. **794 555**

Converting naphthalic acid into naphthalene-2 : 6-dicarboxylic acid. Henkel & Cie, Ges. [Addition to 756 472.] **794 803**

Removing water from halogenated hydrocarbons containing water. Columbia-Southern Chemical Corp. **794 410**

Production of 2, 2-bisphenolic propane compounds. Union Carbide Corp. **794 476**

Azobenzene derivatives and salts thereof and a process for the preparation thereof. Hoffman-la Roche & Co. AG., F. **794 709**

Dicoeramidonines. Farbenfabriken Bayer AG. **794 807**

Method for the mononitration of p-chlorotoluene. Fairweather, H. G. C. (General Aniline & Film Corporation.) **794 558**

Ethylene glycol purification. Union Carbide Corporation. **794 808**

Production of nitriles. Ruhrchemie AG. **794 559**

Hydrogenation of petroleum fractions. Esso Research & Engineering Co. **794 809**

Formation of phosphate coatings. Pyrene Co., Ltd. **794 717**

Steroids. Upjohn Co. [Divided out of 794 485.] **794 489**

Production of pure germanium and silicon. Kirby, H. D. B. (Siemens & Halske AG). **794 642**

Compounds and plant growth regulating compositions containing them. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **794 621**

Modified aromatic-hydrocarbon-aldehyde resins. General Electric Co. [Divided out of 794 646.] **794 647**

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Age Limits: 35-45.
Duties: Investigation in connection with industrial development and the solution of technical problems.
Salary: In the scale £1,737-£2,241 p.a.

(2) **SENIOR SCIENTIFIC OFFICER**
Qualifications: Good honours degree in chemistry or equivalent professional qualification and at least three years' post-graduate training or approved experience. Research experience in chemical or processing industries desirable.
Age Limits: 28-35.
Duties: To undertake investigations required for the development of industrial processes and the solution of technical problems.
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